

Popular Mechanics

MARCH 1981 \$1.25

Build this
greenhouse
garden shed



FIRST DRIVE REPORTS:
Ford's nimble new sports
cars: EXP and LN7

16 COMPLETE PLANS

- 5 basic shop aids to build yourself
- 3 stylish planters you can make
- A craftsman prize-winning wardrobe cabinet ...and more!

MANTA

Conna Valley, Ariz.

Popular
Mechanics

**PM's
GIANT
ROAD
TEST**

We rate 16 of
the world's
fastest cars
WITH
STIRLING
MOSS and
PHIL HILL

LAMBORGHINI
COUNTACH



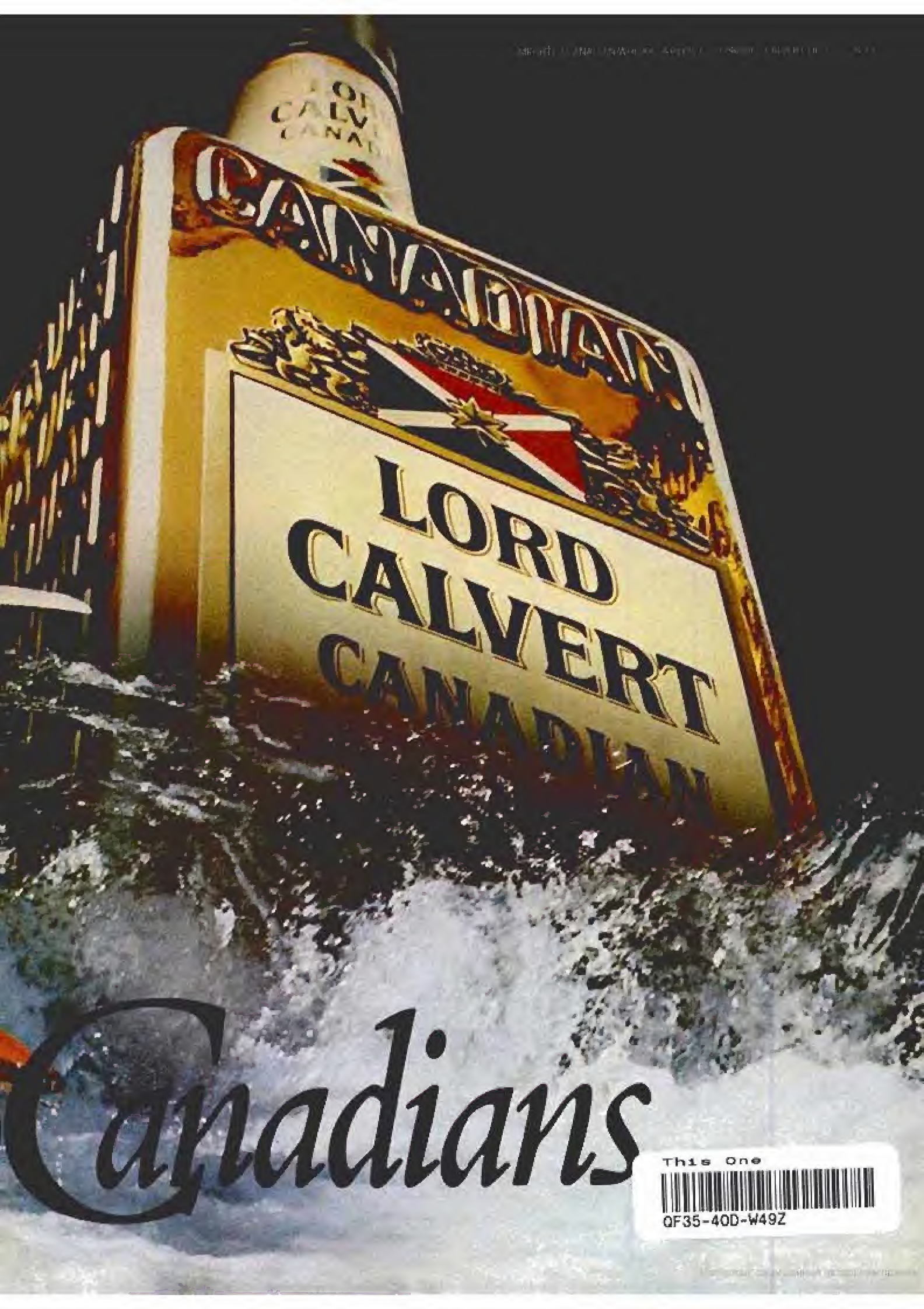
How daring pilots are conquering deadly spins



Go for the best from the North. A Canadian
so good, it takes the efforts of four great
distilleries from Manitoba to Quebec
to make the superb taste of one great whisky.
Lord Calvert: The Lord of the Canadians.

A full-page photograph of a kayaker in a red kayak navigating white water rapids. The kayaker is wearing a red helmet and a green life vest. The kayak is red with a yellow stripe along the bottom. The water is turbulent with white foam. The text "Lord of the" is overlaid in a large, black, serif font at the bottom of the image.

Lord of the



Canadians

This One



QF35-40D-W49Z

RCA's 1981 COLORTRAK SEPARATES BLACK AND WHITE...



FROM COLOR...



**SO EVEN THESE SUBTLE SHADES OF BLUE
COME OUT CRISP AND CLEAR.**

RCA's ADVANCED DETAIL PROCESSOR* MAKES IT POSSIBLE.

1981 ColorTrak represents the finest color TV picture in RCA history!

One big reason is RCA's advanced Detail Processor. After it separates the color picture information from the black-and-white, it processes this information separately and recombines it. The result is a color picture of remarkable crispness and clarity, and high-detail scenes virtually eliminating rainbow effects or crawling edges.

And with the help of RCA's eight automatic color systems, the Detail Processor automatically locks the right color on track. So our finest color picture yet *stays our finest color picture yet!*



You can enjoy the 1981 ColorTrak in the most popular screen sizes and stylings. With a 17-function remote control, the most advanced in

ColorTrak history. And, in some models, Dual Dimension Sound, an RCA feature that simulates stereo and brings *sound*, as well as a clear color picture, closer to life.

Ask your RCA Dealer for a demonstration of ColorTrak 1981. Remember, we introduced color TV a generation ago. And you're about to see the finest color picture we've ever produced.

*Available on most 1981 ColorTrak models. Simulated TV picture. 25" diagonal set shown is "The Dimension" model GER790SR. For the complete line of ColorTrak models, write: RCA Consumer Electronics, Dept. 32-512, 600 N. Sherman Drive, Indianapolis, IN 46201.

COLORTRAK

RCA



RCA IS MAKING TELEVISION BETTER AND BETTER.



On the cover

The Lamborghini Countach is out ahead in this artist's interpretation of PM's million-dollar road test. Beginning on page 112, read how ace drivers Phil Hill and Stirling Moss rated 16 of the world's most expensive high-performance cars, pitted against each other on PM's special course.

—PM painting by Ed Vaigursky

Popular Mechanics®

MARCH 1981

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RAM TOUGH DODGE PICKUP. NEW DESIGN FOR '81. BUILT TOUGHER. BETTER MILEAGE.



New tailgate. Easier operation. More galvanized steel.

More galvanized steel in box. Fights rust in critical areas.

Redesigned roof line, aerodynamic side styling. Reduce drag coefficient.

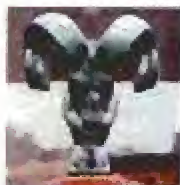
New parking and turning lights. Relocated to avoid stones, parking damage.

Strengthened steel areas around hood, fenders and grille.

Massive impact grille. Resists dents.

3-year corrosion perforation limited warranty.

Under this Chrysler Corporation warranty any part of the 1981 Dodge Pickup, except exhaust system components, which develops perforation from corrosion in normal use within 3 years of retail purchase will be repaired without charge for parts or labor, regardless of mileage. See dealer for details.



more strength, durability and efficiency

Last year Dodge introduced Ram Tough...a line of trucks engineered beyond "tough." For 1981, Dodge Pickups have a bold, new look, with even

More than Ford or Chevy.

This year, Dodge achieves the best EPA gas mileage estimates* with automatic transmission. Improved aerodynamic styling, reduced weight, and the dependable, efficient Slant Six engine all contribute to this Ram 150's superior gas mileage.

More than Ford or Chevy.

Last year Dodge Pickups had more galvanized steel than Ford or Chevy. This year we've more than doubled the galvanized steel that provides critical area rust protection, maintaining our lead over Ford and Chevy.

We weld our pickup boxes to cross sill brackets. Ford and Chevy bolt theirs through the box. Brackets eliminate rust-prone bolt holes.

Ram Tough suspensions help give Dodge Pickups the biggest standard payloads. Our 8-foot box has more load area than Ford or Chevy.

That's Ram Tough, 1981-style. Tougher on the outside. Tougher on the inside. Tougher on the competition. See your Dodge Ram dealer about buying or leasing a Ram Tough Dodge today!

18

EPA
EST
MPG

22 EST
HWY

With standard Slant Six engine, optional automatic transmission. Use EPA est. mpg number for comparison. Your mileage may vary depending on speed, distance and weather. Actual fuel mileage will probably be less. Call us lower.



DODGE TRUCKS ARE RAM TOUGH

Satisfaction guaranteed or your money back. If you're not satisfied with your new 1981 Dodge truck, just bring it back in good condition with no metal damage within 30 days or 1,000 miles, whichever comes first. When the dealer gets clear title, you'll get your money back, excluding finance and insurance charges. Trade-in refund may differ from trade-in allowance on retail sales contract. Ask participating dealer for details.

**I don't like surprises
with my service bill.**



Mr. Good

That's why it's good to know Mr. Goodwrench.



He puts his name on the line. I get a written estimate from Mr. Goodwrench without even asking. That way I know in advance just about what the work will cost. No nasty surprises when I go in to pick up my car. And if he finds anything else wrong, he'll get my OK before doing any work. Best of all, Mr. Goodwrench is committed to reasonable prices that are competitive with those of other places I could go for service around here.

Mr. Goodwrench has GM parts. It's important to me to keep my GM car GM all the way through. So naturally, I specify genuine GM parts. Mr. Goodwrench keeps a good supply of them available, and that helps me get back on the road fast.

He's trained by GM to understand GM cars. Mr. Goodwrench has General Motors training available and he has the right equipment to help him analyze problems and fix my car right. So when my car needs service I watch for a Mr. Goodwrench sign. You'll find it at more than 5,000 GM dealers. Across America.



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AT PARTICIPATING INDEPENDENT MR. GOODWRENCH DEALERS SELLING CHEVROLETS, PONTIACS, OLDSMOBILES, BUICKS, CADILLACS, GMC AND CHEVY TRUCKS.

LETTERS TO THE EDITOR

Use those seat belts!

Moss Miller is to be commended on his thoughtful article on how to avoid traffic accidents (7 *Major Causes of Highway Accidents and How to Avoid Them*, page 87, Nov. '80).

Mr. Miller noted the extraordinary benefits from safety belts, especially on short trips when they are often overlooked. These benefits are further supported by a recent study from the University of Michigan.

This study concluded that, in tow-away crashes, the right front-seat passenger and driver would halve their chances of dying by using their safety belts.

ROBERT M. CALVIN, MANAGER,
HIGHWAY SAFETY PROGRAMS
HIGHWAY USERS FEDERATION
WASHINGTON, D.C.

Still a good project

When I was a much younger man, I clipped plans from PM for building a

model of an ancient Greek trireme warship. About two years ago, I started the project and now, at the age of 76, have finished it (photo below). It's a conversation piece that causes much discussion.

I would appreciate knowing when



Forty-three years later, reader Paul Dufault completes PM model of Greek trireme.

the plans were published, since I no longer have the magazines they were clipped from.

PAUL L. DUFAULT
NORTHVILLE, MICH.

You are to be congratulated on your excellent craftsmanship. Our magazine pages were not dated in those days, which is why you could easily lose track of when the project was published. It was entitled War Galley, 600 B.C. and ran in 1938 in two installments—Feb., page 280 and March, page 441. For others who may be interested, copies of the articles, which total 11 pages, are still available. You can obtain them by sending \$2.75 to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Such warships, incidentally, were called triremes because they had three banks of oars on each side. The one PM modeled was propelled by 172 oarsmen and had a ram on its bow for piercing enemy ships.

We're glad to hear it

My husband and I are avid readers of PM, and we both enjoy the approach to life that your magazine takes. We enjoy knowing that there

The Ugly Stik® rod. It forgives



are other people out there who do care about this world of ours and about our dignity as human beings. We are building a passive solar home, as we feel this will further our independence of the system. At the same time, we know we are doing our part to conserve energy in the best way possible. It is still possible for a man to design and build his own home and have it entirely paid for. This has been a real experience for our family.

DOTTY GRAHAM
ANTIOCH, CALIF.

I just want to say that your magazine is fantastic. It is easy enough for the average reader to understand, but also informative enough for a good mechanic.

ELIZABETH A. ENGELLE
TELFORD, PA.

Shocking poll on solar power

I am shocked by the negative report on solar-power satellites in your Dec. '80 issue (*Tech Front Lines*, page 115). I feel this is a case of a minority that shouts very loud, drowning out the majority.

The 412-person study by the Citizens' Energy Project was not the

only survey made on attitudes toward SPS. In a much larger study by the L-5 Society, in conjunction with DOE, SPS fared quite well. I feel you may have given the impression that the poll was a scientific one that reflects overall public opinion.

I don't know if this letter will be printed, but I hope you will give equal time to positive views without catering to a minority group that was picked because its response could be predicted.

MICHAEL C. STRONG
SWARTZ CREEK, MICH.

We agree the poll sample seems small—we were merely reporting the results, not supporting them. As we also reported, DOE was not swayed by the results, either, and intends to push for the SPS project.

More on 'sky hook' takeoffs

In your Dec. '80 issue (*Letters*, page 6), Greg Higginbotham says, "About 50 years ago, they thought of using gigantic dirigibles as aircraft carriers. All the farther they got in practice was a single biplane fighter, dangling beneath a dirigible, to be air-launched for warding off enemy balloon-busters."

Mr. Higginbotham is only partly right. He is referring to the dirigible *Los Angeles*. However, both the *Akron* and *Macon*, built in the early '30s, had hangar space for five pursuit planes. These were launched and picked up by a trapeze and hook arrangement. On one occasion, six pilots made 104 takeoffs and hook-ons in three hours. This sounds fairly successful to me.

LEON H. HERTZOG
STEVENS, PA.

Yes, but the fact remains that however successful such tests may have been, nothing much ever came of the idea. It took the modern, high-speed helicopter to revive it. For this latest approach to a fascinating concept, see the "Flying Catapult" in Tech Front Lines, page 104, Sept. '80.

Helpful jewelry-making tips

Your article *4 Silver Jewelry Gifts to Make in Your Shop* (page 94, Dec. '80) was very well written. I'm starting to work with silver, and your tips on how to avoid some of the mistakes I've been making were most interesting and helpful.

ED BUESSELER
SPRING GROVE, ILL.

a multitude of sins.

Funny what even the most experienced fishermen seem to catch on the way to a fishing trip.

Which is why more and more of them bring along the Ugly Stik rod by Shakespeare.

It's built to take on whatever stands between a fish and a fisherman.

But it's also built to do something every fisherman loves to do—catch loads of fish.

To build a rod with unmatched strength and sensitivity, we use an exclusive Shakespeare Double-Bilt™ process.

First, we embed butt-to-tip boron filaments in a spiral of sensitive graphite fibers. So no matter how slight the nudge or nibble, you feel it instantly.

Then we cover it with a tough outer layer of fiber-

glass. So you get a rod that can take what you catch, no matter where you catch it.

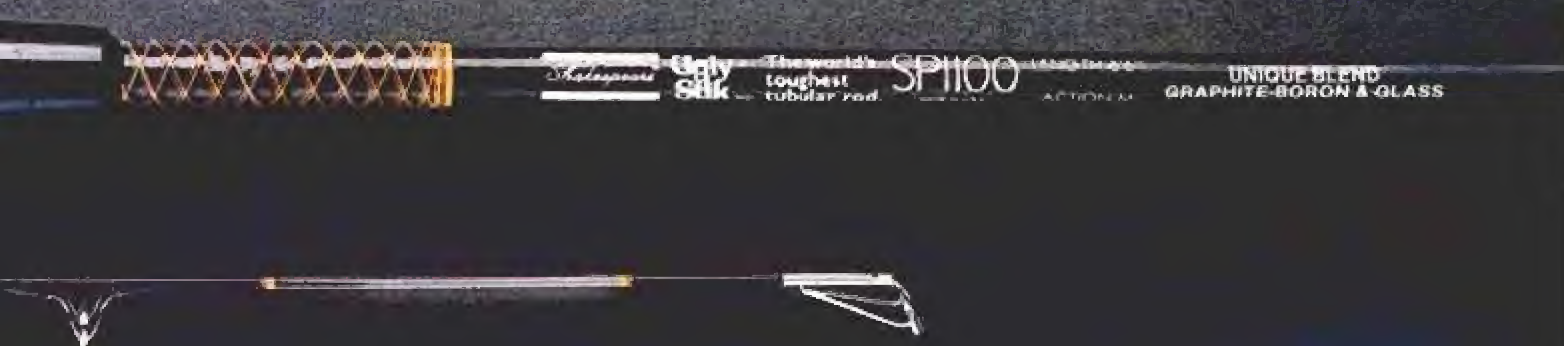
Remember that the next time you hook up with the unexpected.

Because, after all, to err is human. But to forgive takes an Ugly Stik rod.

And remember, for the best results when you go fishing, be sure to use a new Sigma™ reel and Sigma monofilament—the best all-around fishing combination ever invented.

Shakespeare Ugly Stik

America goes fishing with Shakespeare.



SCIENCE WORLDWIDE



A Nimbus satellite follows course rowed by Peter Bird, shown here 100 miles off Mexico.

Satellite tracks a rowboat

The Nimbus 6 satellite is tracking the progress of a 33-year-old London photographer as he attempts to row single-handedly from California to Australia.

At this writing, the oarsman, Peter Bird, was reported to be about 1600 miles southwest of San Francisco and proceeding on course to Brisbane at the rate of about 30 miles a day. The Nimbus, launched by the National Aeronautics and Space Administration (NASA) in 1975, picks up signals from an 18-inch-long, plastic-wrapped beacon aboard Bird's 35-foot craft. Signals to space, marked with a distinct code signifying the rowboat, are relayed to Bird's shore station in San Francisco. There, Kenneth Crutchlow, Bird's U.S. contact, marks his latest position with a green pin on a 4x8-foot map.

Crutchlow tells PM that the Nimbus coordinates provide the only information on Bird's solo voyage. His radio has apparently broken down, Crutchlow says, "but it's clear from the progress he's making on his course that he's still aboard and rowing."

NASA's involvement in the expedition marks the first time Nimbus has tracked a rowboat. The veteran spacecraft has been used by scientists to monitor ocean currents, pack ice, weather systems and animal migrations.

In addition to testing Nimbus's ability to locate small objects on the surface, the Bird voyage is expected to provide psychologists with data

on the effects of long isolation on human beings. Bird carries a variety of books, tapes and radios for entertainment. But no one is certain that these will compensate for the lack of human contact. Bird's estimated time of arrival: August at the earliest—more than nine months after shoving off from Baja, Calif.

Flame-retardant controversy

A professor of chemistry at Florida State University reports finding traces of a flame-retardant chemical, Fyrol FR2, in the semen of about a quarter of 123 male students examined. Prof. Ralph Dougherty says the chemical may be behind the documented decline of male fertility in America. The chemical, which Dougherty says is toxic, is used in some foam mattresses, auto seats and furniture.

Makers of FR2, Stauffer Chemical Co. of Westport, Conn., tell PM that no previous tests have indicated any medical hazard. Complaints from the company to the American Chemical Society, which first publicized Dougherty's findings, caused the society to take the unusual step of withdrawing its news release.

Dougherty tells us that the release was accurate, although somewhat sensationalistic. He says he cannot prove FR2 reduces numbers of sperm, although he reports a correlation between the increasing amounts of the chemical and decreasing sperm count. His full findings were accepted by *Science* for publication sometime this year, he says.

Contrails and clouds

University of Illinois scientists report that jet trails, woven over portions of the Midwest, have cut sunshine and increased cloudiness throughout the area.

Researchers at the Illinois State Water Survey also conclude that contrails in "jet alley," a traffic corridor from northern Ohio across portions of Illinois, Iowa and northern Missouri, have reduced temperature extremes. The scientists say that since jet traffic increased in the late 1960s, there has been an increase in clouds at high altitudes—20,000 feet and up—where jets commonly fly. The increased cloudiness lowers temperatures by day by reflecting sunshine back into space, and increases heat at night, when clouds bounce warmth back to the ground.

Sex and math

Two Johns Hopkins' researchers have produced some volatile ammunition in the battle of the sexes. They have come out with a study suggesting that males are innately better than females are at math.

Camilla Benbow and Julian Stanley, writing in *Science*, say their research supports a hypothesis that "sex differences in achievement in and attitude toward mathematics result from superior male mathematical ability. . . ." Benbow and Stanley found a substantial difference in mathematical reasoning ability—as measured by the College Board's Scholastic Aptitude Test—between boys and girls with essentially identical educational experiences.

Many say the math research doesn't add up. One objection: Boys and girls in the study may have had identical course work, but different extracurricular experiences. Attitudes of parents and even the kinds of toys students played with as children could have had a profound effect on their later test-taking. **PM**

BY GURNEY
WILLIAMS III



A man wearing a black cowboy hat, a white tuxedo shirt with a black bow tie, and a black tuxedo jacket. He is smiling and has his hands clasped in front of him. He is standing against a solid orange background.

Velvet feels like a million

Premium. Imported.

BLACK VELVET® BLENDED CANADIAN WHISKY, 80 PROOF
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The first ultra



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That Cigarette Smoking Is Dangerous to Your Health.

Only
5 mg

5 mg. "tar", 0.5 mg. nicotine av. per cigarette by FTC method.

Ultra

low tar built on taste.



SPACE

You don't have to look to the future to get the kind of roominess, comfort and high fuel efficiency your family needs.

Just look to the 1981 Zephyr.

Zephyr gives you more combined passenger and trunk space than such "X" cars as Skylark and Omega



ZEPHYR FROM L

*Compare to estimated MPG of other cars. Your mileage may differ depending on speed, weather conditions, and trip length.

TRAVEL



(based on EPA volume index).

And long distance mileage?

Zephyr is rated at an impressive

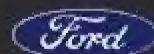
23* EPA EST. MPG, 34 EST. HWY.

Along the way, you'll enjoy the comfort and style you've come to expect from Lincoln-Mercury.

The 1981 Zephyr. Suddenly, the future of your family's travel never looked brighter.

ZEPHYR

LINCOLN-MERCURY DIVISION



LINCOLN-MERCURY

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**"When I listen
to a cassette
I take it apart."**

-Stevie Wonder-

Stevie's reputation as a perfectionist is well known. Before he takes a cassette home, it must deliver big studio sound. The kind of sound he can't take apart.

The cassette Stevie likes most is the high bias TDK SA. TDK SA has a startling musical memory. You'll hear the full timbre of the human voice. The vibrant dynamic energy of strings. The blast and bluster of rock. No nuance is beyond its range. No instrument is forgotten.

The world's major deck manufacturers, themselves perfectionists, use the SA to set the sound standard in their machines. TDK makes sure it will keep setting standards. The shell alone goes through 1,117 checkpoints. With a lifetime* warranty for every part. That makes it easy to like. And hard to take apart.

*In the unlikely event that any TDK cassette ever fails to perform due to a defect in materials or workmanship, simply return it to your local dealer or to TDK for a free replacement.

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NOTES FROM THE EDITOR

John A. Sittler

We have a real challenge for our woodworking readers in this issue of PM. It's a construction project—an armoire—that will give you a chance to awe your family with your best craftsmanship. But the real challenge is this: Match the workmanship of 17-year-old Randy Begin, a high school senior who won first prize in national competition with the original piece that he designed and built. A student at Salem High School, Salem, Mass., Randy constructed the armoire under the direction of instructor Michael Voolich. The two then entered the fine cabinet in the annual high school competition sponsored by Stanley



Randy Begin with his prize-winning armoire.

Tools, where it won first prize. PM's Home and Shop Editor Harry Wicks, a contest judge for four years now, liked the armoire so well that he arranged to print Randy's plans here.

The piece in the color photo on page 140 is the one Randy built; it was photographed in his parents' bedroom, where it remains the second in a six-piece set that Randy is building for them. (Readers who want more information about the competition should write Paul B. Muenzen, Manager of Educational Marketing, Stanley Tools, 600 Myrtle St., New Britain, Conn. 06050.)

Car buffs on our staff had their taste of paradise when we gathered 16 of the world's grandest cars and wrung them out on California's Ontario Speedway (page 112). Every car was a true Walter Mitty fantasy machine. The logistics of the event might have daunted lesser souls than Auto Editor Tony Assenza and Rich Taylor, who made most advance arrangements from our New York office. Anyway, it all came together, with Stirling Moss flying in from London, Phil Hill driving in from Santa Monica, and a Mercedes-Benz 380 SL flying in from Germany—just to cite a few. We did have a few palpitations the next week when BMW called to ask: "Where's our 633 CSI?" As it turned out, the \$33,645 car had been overlooked in their own parking lot. It seems you can get used to having such cars around. **PM**



On a pit stop during PM's giant road test (page 112) are PM team members Dan Coleman, publisher; Phil Hill and Stirling Moss, legendary race drivers; Bruno Michetti, West Coast manager; Tony Assenza, auto editor; and Rich Taylor, contributing editor. The grueling test proved to be every car enthusiast's dream.



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"If any Craftsman® hand tool ever fails to give complete satisfaction, return it to the nearest Sears store in the U.S. and Sears will replace it free." This full unlimited warranty tells you a lot about Craftsman tools—and about Sears.

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When you buy a Sears product, you should be able to count on Sears for good design, good workmanship, good materials, and good value.

So Sears digs into the details. If you were to visit the factory that makes the Craftsman pliers in our picture, you might run into a Sears engineer working to streamline production methods. Or a Sears tool buyer discussing possible improvements—perhaps a slight change to make the handle more comfortable.

At the Sears Laboratory, you would see some of the tests that over *ten thousand* of Sears products

go through every year. Tests of children's swing seats for strength, of bedding for flame resistance, of washing machines for performance.

After Sears approves a product and offers it for sale, Sears responsibility carries on. If what you've bought requires installation, Sears will make sure it's done right. And when it comes to service, Sears runs one of the world's largest service organizations, with Sears-trained repairmen buzzing around all fifty states in over 16,000 service trucks.

It all adds up to a sense of responsibility to you that starts with the development of the product—and stays alive and active after the product enters your home. From sewing machines to jeans to towels to tools, for products you can count on, you can count on Sears.

Sears

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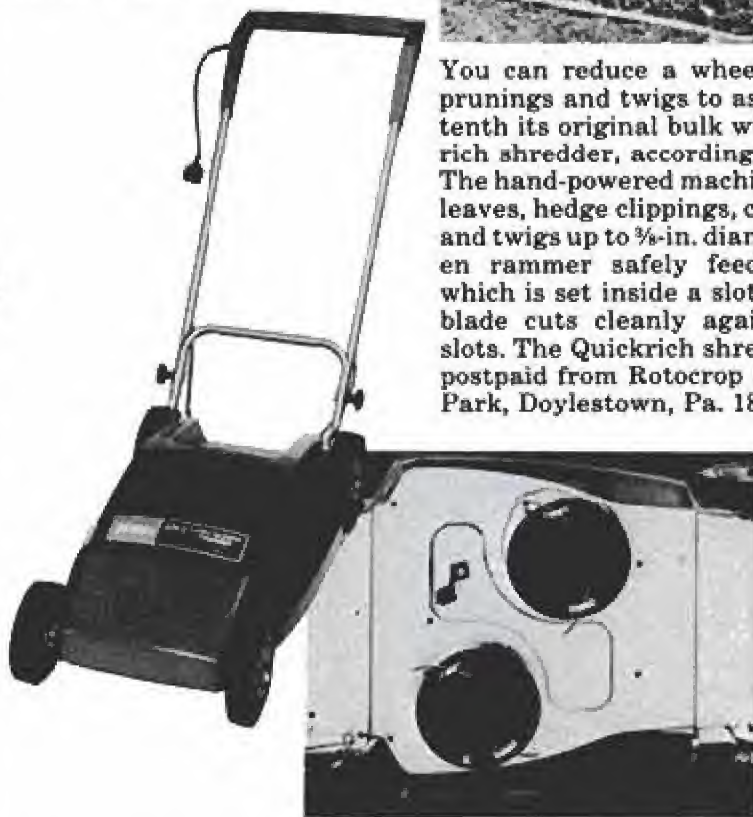
8 new products for yard work



Used as a cart (left) or dolly (below left), the MK II Tote Machine garden cart saves time and effort, has a welded tubular-steel frame with $9\frac{1}{2} \times 26 \times 34$ -in. polyethylene bucket, carries up to 300 pounds. It's \$89 at garden centers or from Slacan, Division of Slater Steel Industries Ltd., Box 152, Buffalo, N.Y. 14209. Optional accessories: extension bar for high loads, garbage-bag holder and tie-down strap.



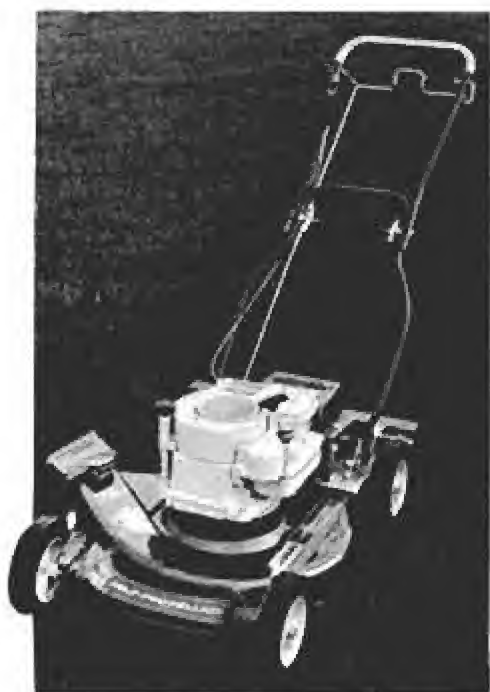
You can reduce a wheelbarrowful of prunings and twigs to as little as one-tenth its original bulk with the Quickrich shredder, according to its maker. The hand-powered machine shreds wet leaves, hedge clippings, cabbage stalks and twigs up to $\frac{3}{8}$ -in. diameter. A wooden rammer safely feeds the blade, which is set inside a slotted tube. The blade cuts cleanly against the tube slots. The Quickrich shredder is \$82.95 postpaid from Rotocrop Inc., 604 Aero Park, Doylestown, Pa. 18901.



Toro's newest electric mower (above) is the first to use monofilament cutting lines instead of a steel blade. Besides cutting a 20-in. swath, the lines extend $\frac{1}{4}$ in. beyond the wheels so you can trim around objects. Two counter-rotating discs (above right), each having two cutting lines, are powered by separate motors. As the lines wear, a lever feeds out new line and cuts it to the proper length. The price is \$220. Toro Co., 8009 34th Ave. S., Minneapolis, Minn. 55420 makes it.

(Please turn to page 84)

The 20-in. self-propelled Model B726 mower by Ryan (left) features a controlled discharge, baffled 14-ga. steel housing and 3.5-hp Briggs & Stratton four-cycle, vertical-recoil-start engine. The rear-wheel-drive mower has finger-tip height adjustment to five positions and wheel-assembly reinforcing in the housing. It's \$244. Write to Ryan Lawn-Care System, Outboard Marine Corp., Galesburg, Ill. 61401, for more information.





Got a ceiling problem?

Cover it up! Dress it up! Light it up! Quiet it down! With a new Armstrong suspended ceiling.

Whatever your ceiling problem—covering up an old or damaged ceiling, adding a new room, or finishing off a basement—an Armstrong suspended ceiling is a problem-solver with style. Beautiful. Washable. Fire-retardant for extra protection. Acoustical to help quiet down any room. Preengineered for energy-efficient fluorescent lights.

Best of all, with an Armstrong suspended ceiling, like Royal Oak shown above, solving your ceiling problem is a do-it-yourself project. There are no staples or glue to mess with, no plastering or sanding. The big 2' x 4' ceiling panels simply drop into the color-matched Super White Grid. The ceiling is easy to install and easy to keep looking fresh and new. If a panel gets damaged, just lift it out, and lay in a replacement.



If lighting is a problem, you can install Armstrong fluorescent fixtures with the ceiling . . . for lighting where you want it, not just where the builder put it.

You can install a beautiful new Armstrong suspended ceiling almost anywhere in your home. Briefly, here's how:

Hang the Armstrong Super White metal runners about three inches below your existing ceiling or open joists (about six inches with light fixtures).

Snap the Armstrong Super White cross tees into the main runners, and lay in the ceiling panels. It takes some time, but it's easy. You can do it!

See your Armstrong ceiling retailer for a broad selection of suspended ceilings. Find him under "Ceilings" in the Yellow Pages. Or send us this coupon, and we'll send you his name and a free full-color brochure.

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HINTS FROM READERS

Squeegee from wiper blade



Make a handy squeegee from a section of old windshield-wiper blade. Cut and shape a $1\frac{1}{4} \times 2\frac{1}{4}$ -in.-wide aluminum U-channel to hold the blade. Attach the channel with two flathead wood screws to the angled end of a $\frac{3}{4}$ -in.-diameter hardwood dowel. Crimp aluminum around back of blade.—Walter E. Burton

Oldie-but-goodie gate return



This old-time gate return is easy to maintain and has a certain charm. Attach one end of a chain to a post inside the yard. The length of the chain determines the gate swing. Suspend a hefty weight from the midpoint of the chain. Attach the other chain end to the gate. The weight causes the gate to swing shut after it's pulled open.—Mitch Pieronek

Draining a new driveway

I used old cement blocks to build up a depression in a proposed driveway. I positioned the blocks side by side across the drive, with the holes lined up to carry off water. After covering the blocks with dirt, I have a strong culvert that a 10-ton truck can cross.

—Charles Apaeki

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Just plug the Guardex 8000 alarm system in, make two simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc., terminals for connecting optional outside siren and back-up battery (not included); entry delay time control and sensitivity control.

The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 3/4" x 9 3/4" x 8") and weighs less than 6 1/2 pounds.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from the main alarm, they are available with 50 feet of wire for \$24.95. (Connecting terminals are provided on the back of the alarm).

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only \$199.95. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of \$199.95 plus \$3.50 postage and handling. If you want the optional outside siren, add \$24.95 (California residents add 6% sales tax.)

(If you require more information, call during California business hours, Monday - Friday).

Dealer Inquiries Invited

CALL TOLL FREE
(800) 423-5499

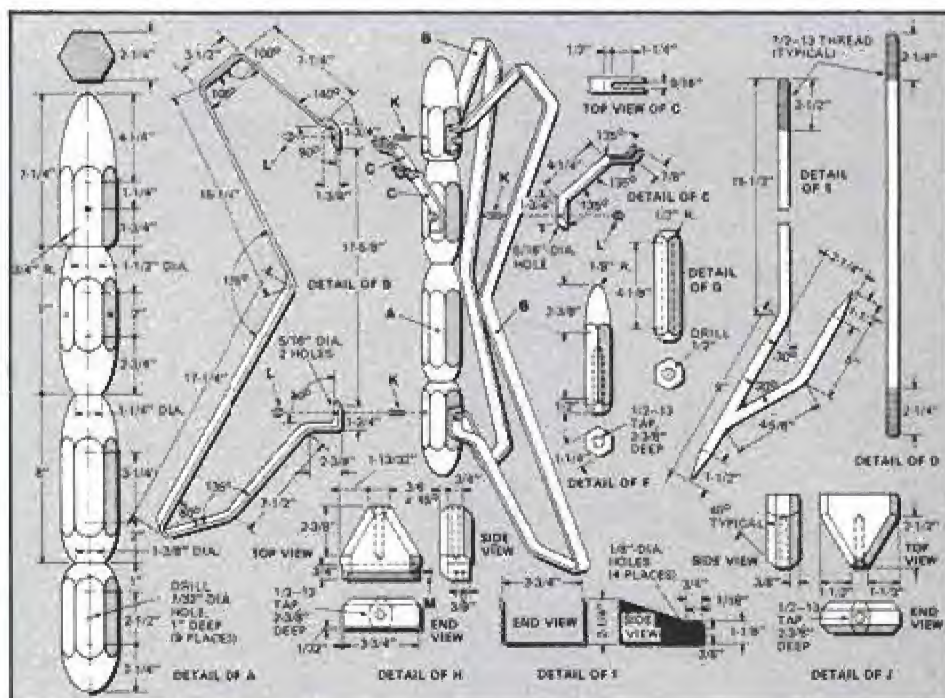


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**GUARDIAN
ELECTRONICS, INC.**

31117 Via Colinas, Dept. PM Westlake Village, Calif. 91361

FIREPLACE SET



holes for hanger bolts (K). Finish-sand with 180-grit abrasive. Shape ends and sand smooth. Dust and tack off. Stain and finish.

Cut blanks for the handles from 21-in.-long stock. After trimming blanks to a hexagonal shape, mount each on the lathe and turn the end tapers. Center-bore the other end for the aluminum rod. Shape the end and sand it smooth; then tap the hole, thread $\frac{1}{4}$ -20. Stain and finish.

Cut center handles (G) from a 16-in. length of stock ripped to a hexagonal shape. File and sand ends and bore center hole through both for half the length. Sand, stain, finish.

Cut legs (B) 2-in. over length. Sand surfaces with 180-grit, then 240 abrasive. Texture the narrow edges only by tapping a center punch with a light hammer. Tape front and back of each leg to prevent scoring while bending. Make the 125° bend and work outward. Cut off excess stock, bore holes and remove tape. Buff front and sides; remove excess compound with lacquer thinner. Paint the leg sides and back with zinc chromate; later, finish with flat black enamel. Remove the paint from high surfaces with fine sandpaper (leaving it in punched marks). Spray legs with clear varnish.

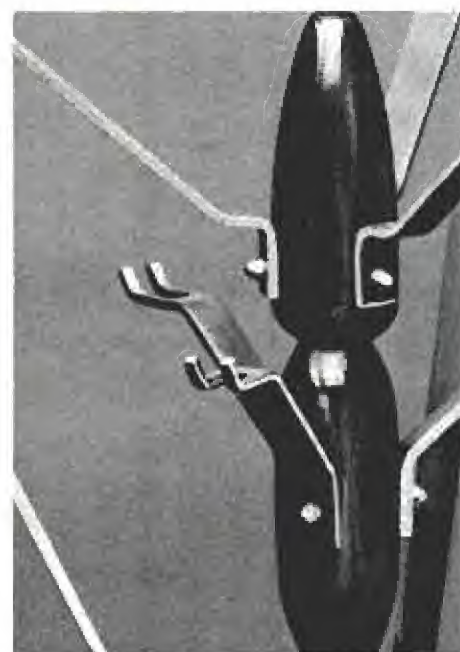
Cut tool hangers (C) oversize; treat same as legs. Mill tool slots.

Cut shovel block (H) to size and shape. Mill cutaway for the shovel frame (I), bore, then tap the hole for

MATERIALS LIST—FIREPLACE SET

Key	Am't.	Size and description (use)
A	1	3×3×28" sugar pine (column)
B	3	$\frac{1}{4}$ ×1×63" 6063-T5 aluminum (stand leg)
C	3	$\frac{1}{4}$ ×1×8 $\frac{1}{2}$ " 6063-T5 aluminum (tool hanger)
D	2	$\frac{1}{2}$ "-dia.×19" 6063-T5 aluminum (tool rod)
E	1	$\frac{1}{2}$ "-dia.×33" 6063-T5 aluminum (poker)
F	3	1 $\frac{1}{2}$ ×1 $\frac{1}{2}$ ×7" pine (handle)
G	3	1 $\frac{1}{2}$ ×1 $\frac{1}{2}$ ×5 $\frac{1}{4}$ " pine (center handles)
H	1	1 $\frac{1}{2}$ ×3 $\frac{1}{2}$ ×3 $\frac{3}{4}$ " pine (shovel block)
I	1	22-ga.×4×8 $\frac{1}{4}$ " cold-rolled steel (shovel frame)
J	1	1 $\frac{1}{2}$ ×3 $\frac{1}{2}$ ×3 $\frac{3}{4}$ " pine (brush block)
K	9	$\frac{5}{16}$ -18×1 $\frac{1}{2}$ " bolt
L	9	$\frac{5}{16}$ -18 acorn nut
M	4	$\frac{3}{4}$ ×No. 2 rh wood screw

Misc.: Bristles from a broom for fireplace brush; glue; stain; finish such as Delft; paste wax; buffing compound; zinc chromate; flat black enamel paint; lacquer thinner; metal primer.



Closeup photo shows the finish on the tool hangers (C) and the legs (B). The texture is created by a center punch which is tapped with a lightweight hammer.

You can sharpen your metal-working skills by building this fireplace set. Cut the pine wood column (A) to length, allowing at least 4 in. extra for lathe centers. Trim square stock to a hexagonal shape and turn shoulders on a lathe. Sand with 150-grit abrasive and bore

the rod. Sand smooth, stain and finish. Cut shovel frame and file the edges smooth. Bore attachment holes and bend frame to shape. Apply metal primer, then black enamel. With frame as a template, mark and bore attachment holes in the block; fasten with screws.

Cut and shape the brush block (J); bore, then tap the rod hole. Bore three rows of holes for the bristles. Sand, stain and finish. Then glue bristles in place with plastic resin.

Cut metal pieces for the poker (E) and taper-turn one end of each. Thread other end of the longer piece. Give the rods a satin finish by sanding successively with 180-, 240- and 320-grit abrasive. Bend the angles and aluminum-weld the parts. File and sand weld and finish. Cut stock for shovel and brush rods (D); thread ends. Finally, assemble parts.—Bill Fifer, James Slabik

accessories for your home

NORWEGIAN SKAMMEL STOOL



Outside of the decorative rosemaling, the distinguishing feature of a skammel is the fingerhole slot cut through the top, by which the stool can be easily carried or moved.

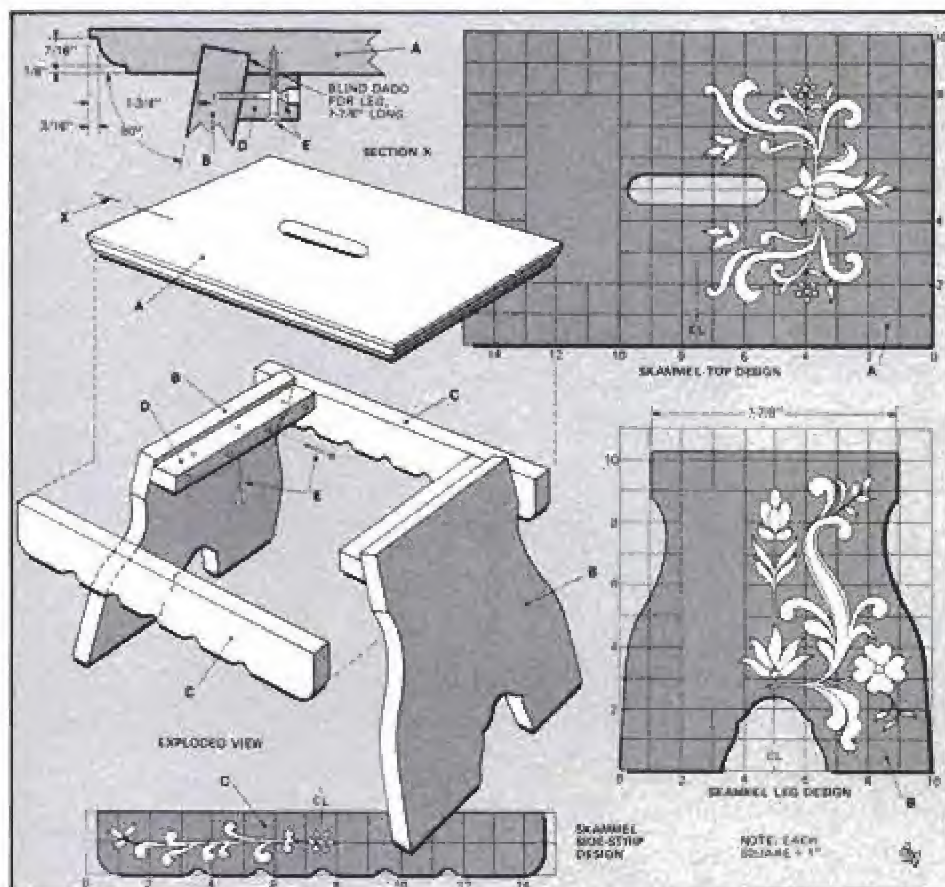


Glue the legs into blind dadoes cut at 80° angle to assure outward slant. Reinforce legs with beveled cleats (D).

This Norwegian milk stool, known as a skammel, is decorated with colorful rosemaling: a traditional style of painting flowers, scrolls and leaf shapes. First cut all parts, then sand them with 120-grit abrasive paper, dust and wipe with a tack cloth. Rout the decorative edge on sides (C). Cut finger slot in top (A).

Cut blind dadoes at an 80° angle in the top to create the mortises for the legs. Bevel cut one edge of each cleat (D) at 80°. Square the round dado ends with a chisel.

Glue legs in their grooves. Bore holes in cleats and attach with glue and screws to the top and legs. Glue aprons (C) in place; clamp until dry. Apply a prime coat of paint or pigmented shellac such as Bin. Sand with 150-grit paper, dust and tack off. Favored colors for rosemaling are blues, greens, rusts and off-white—blended with a touch of ochre or umber from a tube of artist's pigment. Apply two coats of background paint: rust with brown added. Use 220-grit paper between coats. Enlarge the rosemaling pattern full size and transfer it by rubbing the back with chalk or soft pencil, placing this chalked side on the wood and retracing the pattern. You can paint over chalklines. Use acrylic paints thinned to flow without dripping. Apply paints with fine-pointed artist's brushes.—Willard and Elma Waltner



MATERIALS LIST—SKAMMEL

Key	No.	Size and description (use)
A	1	¾" x 10" x 15" pine (top)
B	2	¾" x 10" x 10 ¼" pine (leg)
C	2	¾" x 2" x 14 ½" pine (apron)
D	2	¾" x 1" x 7 ½" pine (cleat)
E	14	No. 7 x 1 ½" in brass wood screws

Misc.: Glue, primer or pigmented shellac; acrylic paints; artist's brushes.

(Please turn to page 72)

T/A[®] HIGH TECH RADIALS

Objective: Create a light truck radial offering off-road traction that's quiet on the road by combining a computer optimized tread design with advanced technology.

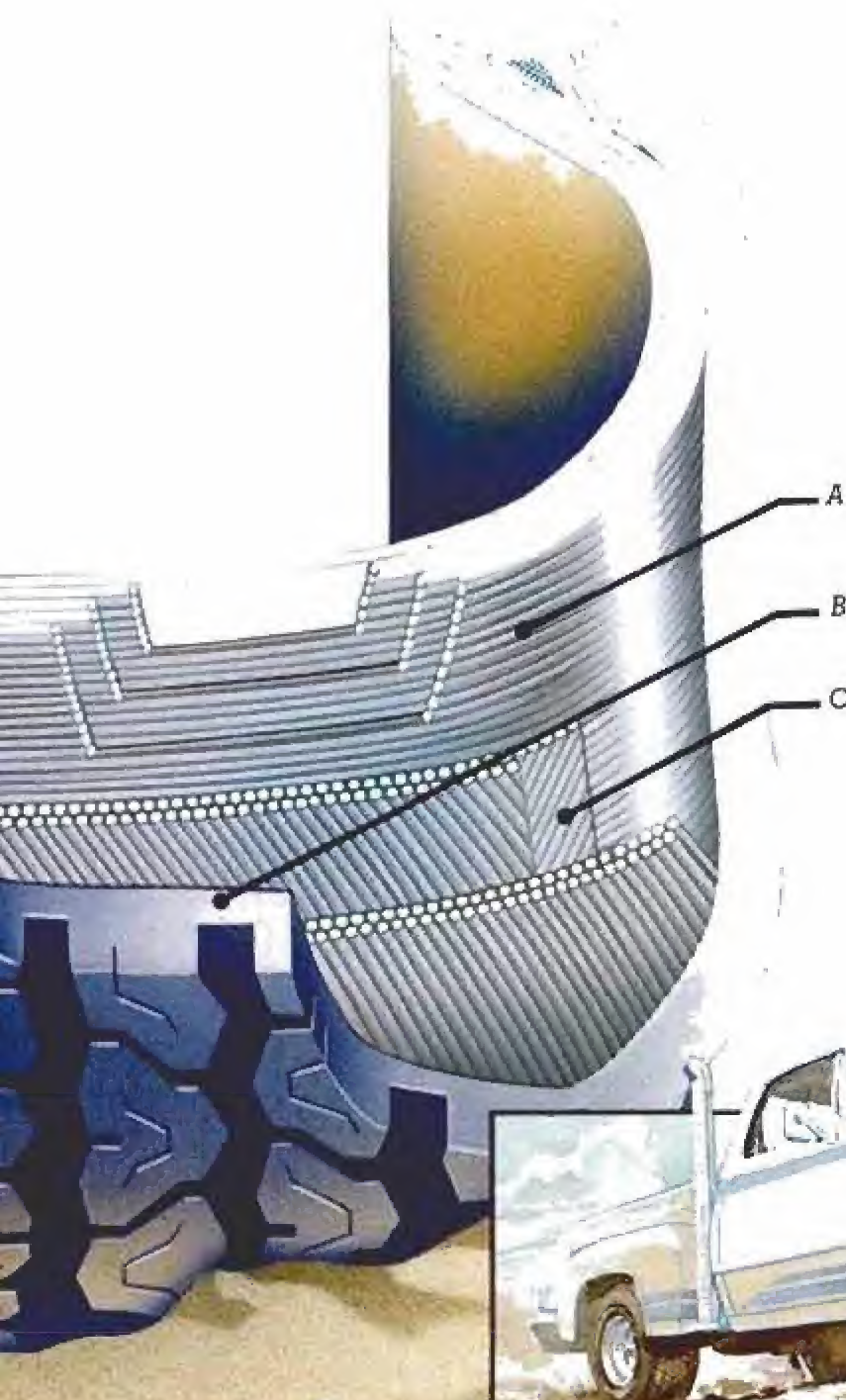


The Radial Sport Truck T/A™ tire has a varied pitch sequence to break up harmonic noise patterns and produce a quiet ride on the highway.

Independent tread blocks with transverse grooves channel water out to help reduce hydroplaning.



BF Goodrich



A. The Radial Sport Truck T/A is constructed with three carcass plies instead of two to provide excellent sidewall bruise resistance and for increased load-carrying capacity over passenger tires.

B. Dual compound tread composition has tough outer layer for long wear, special inner layer to resist heat buildup in tread area.

C. DuroGard® folded belt system provides increased durability in the critical stress area.

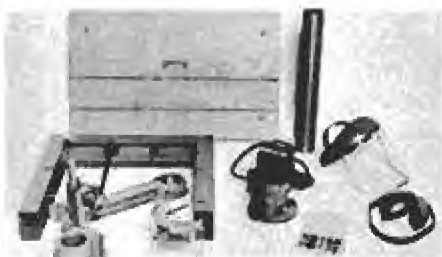
Every Radial T/A tire utilizes state-of-the-art technology to meet the driving requirements of a particular vehicle type. Whether you drive a light truck, a sedan, or a sports car, there's a Radial T/A designed for you. T/A® High Tech™ radials. Truly, the State of the Art.



PM LOOKS AT SHOPSMITH'S ROUTER ARM



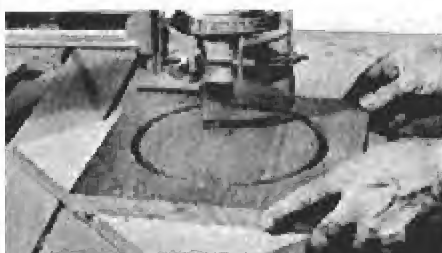
Use a fence to cut a mortise. Stop blocks can be used to limit the cut's length.



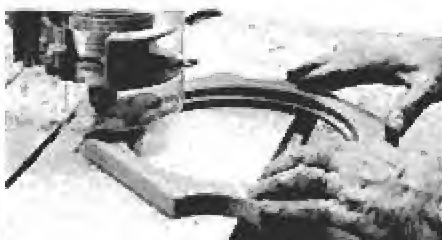
Unit comes from the manufacturer knocked down. It is easily assembled using only a wrench and a screwdriver.



Scrap block with through hole is used to check alignment of the router center over the pin. Block is placed over the pin. Lowered router bit must fit into the hole.



Circle cut is first step in making this picture frame. Notice how smaller workpiece is attached diagonally to the jig.



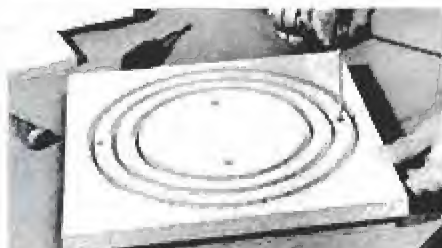
Corner rounding is done freehand against pin. Starting pin (not visible) is used to ease work into cutting position. For full-depth round, use bit pilot as the guide.

One of the latest offerings from Shopsmith is a router arm designed for use with any round router motor from 3 to 4½ in. in diameter. The arm is a precision tool that lets you make fast, accurate router cuts.

The arm, as it comes, is a bench-mount unit. It costs \$379; an owner's manual and operating instructions are included. Shipping is extra and is calculated at



Column must be carefully set, perpendicular to base. Aluminum foil shims are used to make needed adjustments.



Particleboard with laminate surface is ideal jig material, takes much abuse. Screws attach ring jig to work.



Roman ogee bit is used to shape inside edge of the cutout. Rabbet cut on bottom is made when work is removed from jig.



Completed frame. Scalloped corners were cut with band saw. Frame's back is rabbeted to receive picture and glass.

six percent of the complete order.

If you don't own a router that will fit the unit, you can order Milwaukee's 1½-hp Model 5650 for \$149, plus shipping. (That price is for the round motor only and does not include the base and handles.)

Instructions for use are clear. We ran the arm through its paces to create the frame shown. We concluded that this is a quality tool for serious woodworkers. It's also excellent for someone who wants to use his workshop to generate extra income.

Here's how the arm works. The table has a pin block that accepts several different-sized pins. When the pin is aligned, the router bit centers over a pin of matching size. This allows you to pin-route with a jig—a foolproof method for shaping and duplicating both straight and irregular workpieces.

The workpiece is secured to a jig that has a groove of the desired shape cut on its underside. The groove is then placed over the pin in the table, and the assembly is traced over the pin. When you lower the router bit into the wood, it cuts an exact duplicate of the shape. Since the workpiece travel is controlled by the pin, there is virtually no chance for error.

In our opinion, over-pin routing is the most important feature on this tool. But there are other useful operations the arm will handle. For example, if you want to rabbet, shape or groove the inside or outside of an irregularly shaped workpiece, the routing is done against a pin or pilot without a jig. Also, if you work against a fence, you can make accurate straight-line dados, grooves and mortises.

The arm comes in knockdown form, but it's easy to set up; instructions are clear. To use the arm, remove your router motor from its base and attach it with a mounting bracket. To align the router, you slide and tighten the table.

For operation, there are only two controls to contend with: a depth-stop rod that limits the router's vertical travel, and a quill-feed handle that raises and lowers the router. The quill handle locks the router at any depth. For information, write Shopsmith Inc., 750 Center Dr., Dept. 3050, Vandalia, Ohio 45377.—H.W.

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PM ELECTRONICS MONITOR

Plug-in hot rods

Took a first look at GM's new Computer Command Control, a micro-computer that will be in all of its 1981 cars. The computer will monitor and control the engine and emissions-control system.

An example of the type of control this computer exerts can be found in the carburetion cycle. A sensor determines how much air is mixed into the fuel. That info is routed to the computer. The computer then controls a solenoid switch in the carburetor which regulates the air supply.

It's called a "dithering solenoid," by the way, as it has only a full-on and full-off position. So it is almost always cycling back and forth very quickly.

The computer also monitors and controls functions such as coolant temperature, air pump and filtration system, idle speed and manifold pressure. Exactly what the computer does for all these systems will be covered fully in an upcoming issue of PM.

But one interesting thing is that, for all of GM's cars, all the computers are the same. The only difference is in the program that runs each car—the program contained in one plug-in electronic circuit called a PROM (Programmable Read-Only Memory).

GM has more than a hundred dif-

Phone-dial trick

Judging from friends who have installed new telephones themselves, it seems many people don't know how to remove the dial to put their phone number on the paper disc under the center. Here's the trick: On most dials between the digits 9 and 0, you will see a small hole. Turn the dial fully clockwise, then insert a paper clip into the hole. Press down, turn a bit more, and the dial will pop off. To reinstall the dial, press it on and turn until it seats firmly in place.



ferent PROMs—one for each model of car it sells. So the only difference between a computer in a Cadillac and one in a Corvette is in that one PROM chip.

We predict a brand-new aftermarket item—customize your car's performance by buying a customized computer chip.

Want better fuel economy at the cost of quick starts? That would be possible. Also possible, though perhaps sold only "under the counter," would be chips that ignore emissions control and turn your car into a roaring street machine.

The old-time cry of a mean machine "chopped and channeled, bored and stroked" may be replaced with something similar to "hot chipped."

Hair-raising question

One night, recently, I was using the superantenna on my ham radio (see *PM Installs a Superantenna*, page 28, Feb. '81). I had turned the TH5-DX beam so it was pointing east to Europe and Africa and had just finished talking with a fellow ham who was near Paris.

I no sooner signed with him than I was called by CN8AT, a Moroccan call sign. Excited at working (even hearing) my first station from that country, I gave him a call immediately.

Soon I was chatting with Hans in Tangier. We got to talking some and mentioned our respective jobs.

Hans commented to me, "That's a good-looking moustache that you have."

We were not transmitting slow-

scan TV—this was voice only. For the life of me, I couldn't figure out how he knew. Was I speaking too close to the mike and sending bristling noises through the airwaves?

No, Hans replied. When he had heard I was with *Popular Mechanics*, he just opened his subscription copy and there I was pictured on my column.

We both had a good laugh. But I should have guessed. I've discovered that hams all over the world know of PM. In many ways, it is, indeed, a small world.

Triple-talking tape deck

Sharp Corp. will soon release its RD-688AV tape deck, which may revolutionize audio/visual in schools. A portable stereo deck, it also features a separate "sync" track.

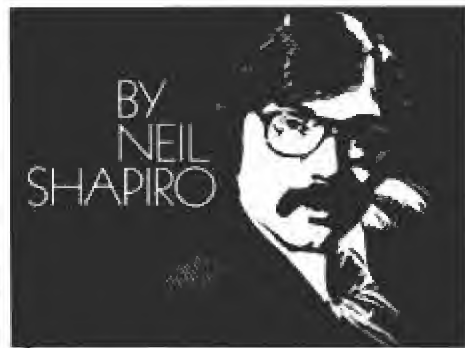
The deck will allow the recording of voice-overs, mixing of live and recorded sounds, and many other classroom uses. This is the first time such sophistication in a tape deck has been made available through the educational marketing channels, and it will retail for under \$700.

PM

Whiskery weigh-in



No, someone's not buying a pound of mouse. It's a new scale with a built-in computer from Ohaus Inc. Little animals that jump up and down have always been hard to weigh. The computer automatically averages readings to give an accurate weight.



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MARCH 16-28

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Stanley quality at a K mart price. Nice.

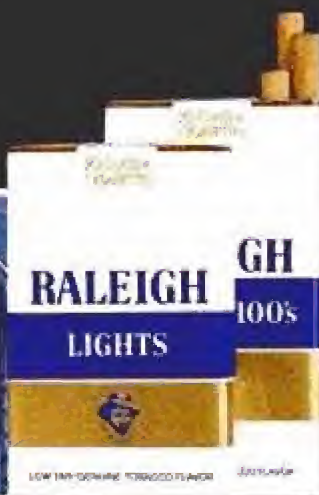
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The low 'tar' with
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RALEIGH LIGHTS

SERVICING DETROIT'S FRONT-WHEEL-DRIVE GENERATION: THE X-CARS, K-CARS AND ESCORT/LYNX

PART 1

by Mort Schultz

PONTIAC
PHOENIX
X-CAR

FORD ESCORT

DODGE ARIES
K-CAR

CHANGING ENGINE OIL

Model	Frequency	Type of Oil
K-car	7500 miles or 12 months	API service SE or SF (2, 3)
E/L	10,000 miles or 10 months	API service SE or SF (1, 2, 3)
X-body	7500 miles or 12 months	API service SE or SF (2, 3)

Footnotes: 1. Ford recommends that as soon as oils labeled API Service SF are available, they should be used; they improve wear protection. SF classification on oil can may be combined with others (SF-SE, SF-CC or SF-CD).

2. API Service FS oil provides better all-around engine protection. However, if you use SF oil, do not alter the recommended oil-change frequency.

3. The procedure for changing oil is the same, car to car. In each case, the oilpan drain plug is readily accessible.

REPLACING OIL FILTER

Model	Frequency	Procedure
K-car*	Every other oil change (1)	Inside engine compartment, using oil-filter wrench
E/L	10,000 miles or 10 months	From below, using oil-filter wrench
X-body	(2)	From below, (special wrench)

1. If car is driven less than 7500 miles in 12 months, replace oil filter at each oil change.

2. If the car is driven more than 7500 miles in 12 months, replace the oil filter at the first oil change and every second oil change thereafter. However, if oil is changed only once a year, replace the oil filter when replacing oil.

*Car marked with asterisk in charts is especially easy to service.

If you're thinking of buying a new car, you may be wondering which 1981 model is the easiest to service—the Chrysler K-car, Ford Escort/Mercury Lynx or GM X-body. I wondered, too, so I spent a week recently in Detroit doing scheduled maintenance

services on all three models.

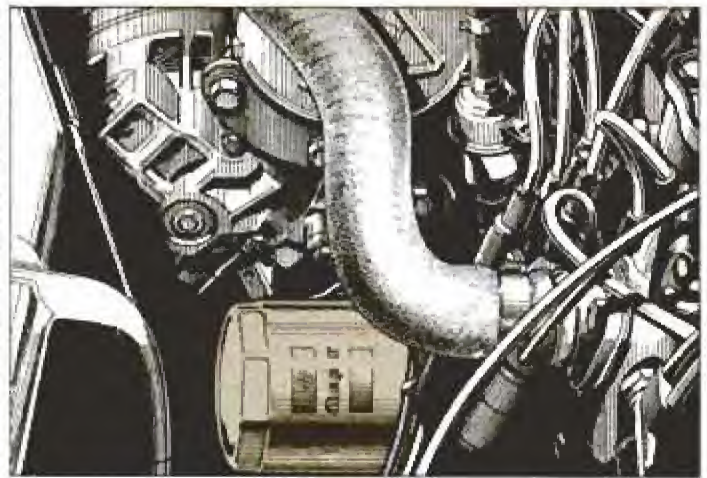
In my opinion, there aren't any cars, foreign or domestic, that are easier to work on than these three. As a group, they are a Saturday mechanic's delight.

The cost of maintenance is de-

lightful, too. According to Chrysler, Ford and GM, during the first five years of ownership, or 50,000 miles of operation, a K-car, E/L (Escort/Lynx) or X-body will cost you about \$35 per year for parts and materials needed for scheduled maintenance.



Oil drain plug of all three cars is very accessible. The oilpan shown (left) is that of an Escort. K-car's oil filter (right) is the only one that can be removed inside the engine compartment. Escort and X-body oil filters must be removed from underneath the vehicle. The X-car needs a special tool to remove filter.



Scheduled maintenance consists of inspection and service procedures specified in the car owner's manual. It is the foundation for maximum vehicle longevity. According to company estimates, you will spend one to four hours a year over the five-year period doing tasks outlined on the schedule.

Note that cost and time estimates assume that no repairs are needed. They also assume that the car isn't used to pull a trailer, isn't driven in dusty areas, isn't allowed to idle for extensive periods, isn't driven less than 10 miles when the ambient temperature is below 10°F. for 60 days or more, and isn't driven more than 50 percent of the time over 70 mph when the ambient temperature is over 90°F.

If the car is operated under any of these extreme conditions, some of the scheduled maintenance services are required every three months or 3000 miles, whichever occurs first, obviously increasing the time and money spent for maintenance.

But which car is the easiest to maintain? The following report comparing the K-car, E/L and X-body answers this question. Where, in my judgment, a particular model stands out above the others in simplicity of design that makes servicing easier, we award it a star (*).

Changing the oil filter

It's a breeze to replace the oil filter in a K-car. It's done from above, and there is ample room for your hands to remove the old filter and install a new one.

In the E/L, the oil filter is wedged above the catalytic converter. The filter has to be replaced from under the car, and if you try to do the job when the engine is warm, you can easily burn your hands on the hot converter. Therefore, to change the oil filter at the same time you change oil, you have to warm up the engine (since oil should always be drained with the engine warm), change oil, then let the engine cool down to replace the filter.

Oil filters of both the four- and six-cylinder X-body engines are posi-

tioned down low on the engine between the engine block and grille bumper. Space is tight.

The easiest way to replace the filter if the car is not lifted is to squirm your body under the vehicle in front of the right front wheel, angling yourself until you can reach the filter. You can't go straight in under the bumper because a deflector plate hanging back of the bumper blocks your path.

AC PF-40 oil filters are installed as original equipment by GM on X-body cars. However, when replacing the oil filter of a car having a V6

engine, you may install an AC PF-51 filter instead. It provides an increased capacity.

AC filters are manufactured in the United States and Great Britain. All filter canisters are fluted, but the diameter of U.S. filter flutes differs from the diameter of Great Britain filter flutes. One is 75 mm, while the other is 70 mm, respectively.

Kent-Moore tool No. J-29142 will fit both canisters, so you don't need two different tools in case you get a U.S. filter on one occasion and a filter made in Great Britain on another.

REPLACING SPARKPLUGS

Model	Frequency	Impediments
K-car*	30,000 miles (1)	None. A straight shot at all four plugs. You don't have to remove the air cleaner.
E/L	30,000 miles (2)	Remove air cleaner and air inlet tube to remove sparkplugs. Plugs are close to the exhaust manifold, so be careful if the engine is warm. Use of an 8-inch socket extension makes the job easier.
X-body	30,000 miles (1)	Plugs of four-cylinder engines pose no problem, but remove the air cleaner for easier access. See below for information about sparkplugs of V6 engines.

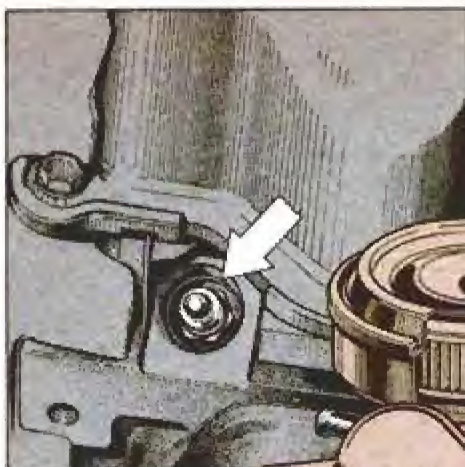
Footnotes: 1. Tapered sparkplugs. No gaskets required.
2. Sparkplugs have steel gaskets. According to Ford, it is not necessary to use new gaskets if the plugs are removed for servicing or inspection.

K-car hood lid can be opened almost to a 90° angle—straight up—giving you ample room for getting at the engine parts.

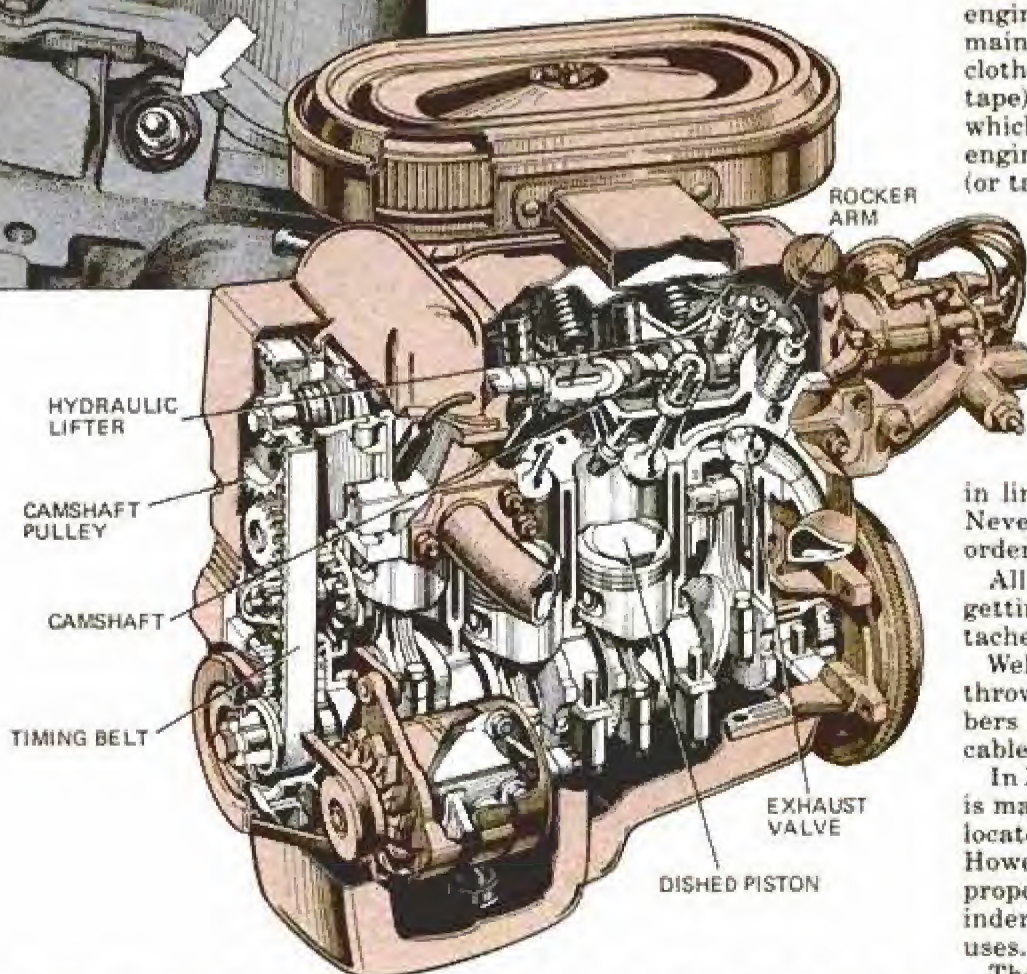


K-car's sparkplugs are the easiest of the three to reach. You don't even have to remove the air cleaner to reach them.





To reach the recessed sparkplugs on the E/L cars (left), the air cleaner must be removed first. The plugs are near the exhaust manifold (below), so be careful. E/L's timing belt must be replaced every 60,000 miles. Valves need no adjusting.



er. When you order an AC PF-40 or PF-51 filter, you can't tell by looking at it where it's been made. Filters made in the United States and Great Britain look alike.

You can purchase oil-filter tool J-29142 from a General Motors dealer or from Kent-Moore, 29784 Little Mack, Roseville, Mich. 48066. The price is \$4.75, including handling and postage. Master Charge (provide Kent-Moore with your card number) or c.o.d. orders are accepted. By the way, the oil-filter tool is expected to fit the oil filters of GM's

new J-car, which will be along this spring.

Replacing sparkplugs

The sparkplug cables in all three cars have large, extended sparkplug boots. You don't need sparkplug cable pullers to remove cables. Just grasp the big boots, twist and pull.

In E/L models with airconditioners, pulling the boot off the No. 1 plug is somewhat difficult, because the alternator bracket blocks the way. Maneuver your hand in from the side. But the E/L has a handy

sparkplug cable feature that'll save Saturday mechanics the chore of marking cables: How do you identify cables when you remove them from sparkplugs to assure that they are reattached in proper sequence, so engine firing order is correctly maintained? You mark wooden clothespins (or strips of masking tape) with numbers in the order in which sparkplugs line up in the engine, and then attach clothespins (or tape) to cables. Right?

For example, in a front-wheel-drive car with a four-cylinder engine, the number on the clothespin (or tape) you put on the cable going to the first sparkplug on the left (facing the engine) would be No. 1. The number on the clothespin (or tape) you attach to the cable next in line would be No. 2, and so on. Never mind that the engine firing order is 1-3-4-2.

All that you need worry about is getting each sparkplug cable attached to the correct sparkplug.

Well, if you buy an Escort or Lynx, throw away your clothespins. Numbers are imprinted in sequence on cable insulation.

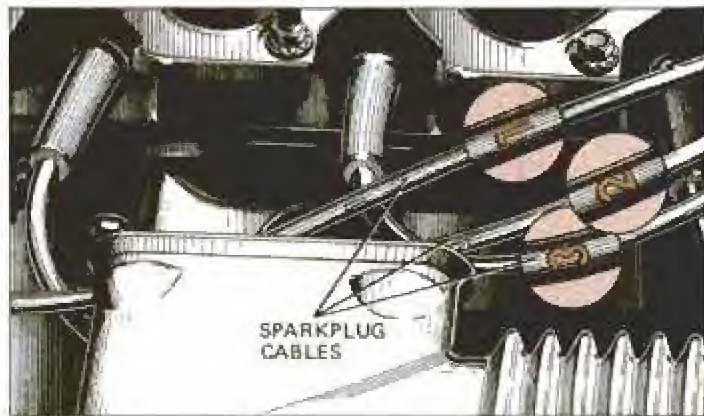
In X-body cars, the distributor cap is marked with numbers, which are located alongside the terminals. However, to get cables attached properly, you have to know the cylinder number sequence that GM uses.

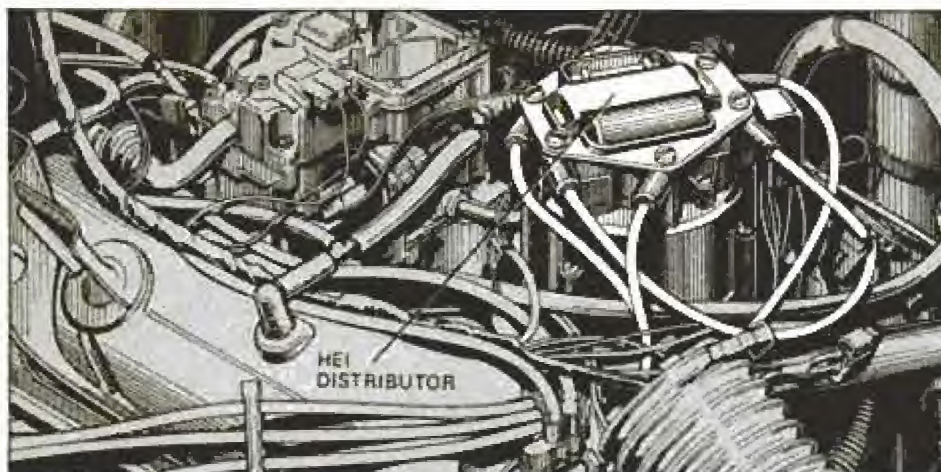
There's no problem with a four-cylinder engine, which has a 1-3-4-2 firing order. The cable connected to distributor terminal 1 goes to the sparkplug of the first cylinder; the cable connected to distributor terminal 3 goes to the sparkplug of the third cylinder, and so forth.

But can you tell which sparkplug cables attach to which terminals in a car with a V6 engine? You can't, unless you know that the three cylinders facing you (closest to the radiator) are numbered 2-4-6 (from left to right), and that the three cylinders facing the firewall are num-



All three cars have insulated boots for the sparkplug terminals. Escort boot is shown at left. E/L sparkplug cables (right) are numbered. This makes it a fast and foolproof procedure when you are reattaching the cables onto the plugs.





The X-car's HEI distributor is accessible after the air cleaner is removed. Sparkplug numbers are stamped on the distributor.

bered 1-3-5, starting at the front of the engine. The front of the engine is the end on the passenger side of the car.

The K-car has no numbers, on either the sparkplug cables or distributor. In this instance, you'll have to use the clothespins.

The firewall-side sparkplugs of the GM X-body V6 engine present car owners with a paradox. In this otherwise easy-to-service vehicle, these are three of the most difficult-to-remove sparkplugs I've ever seen—more so in 1981 models than in 1980 models because of the inclusion of an Air Injection Reaction (AIR) pump.

The best way to get these plugs in and out of the engine is to use a No. 6 extension, swivel and 3/4-inch socket. Work from the left (driver) side of the car, so you aren't hampered by the AIR pump. Feeling your way (your vision is blocked), place the socket on the plug, then attach the swivel and extension.

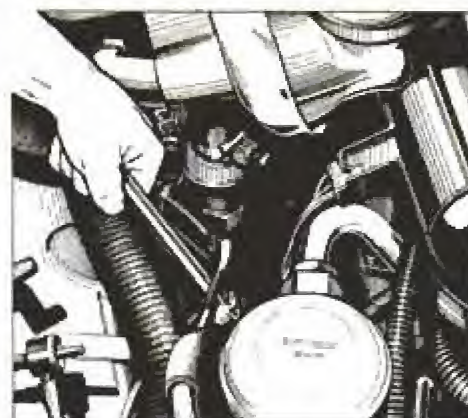
Lubrication

For the K-car, Chrysler recommends that you service rear-wheel bearings if grease is low in quantity, contains dirt or has been contaminated (looks milky).

You should look to see if rollers are pitted or show other surface defects, such as cracks. A slight discoloration of the metal is quite normal. Replace any of the bearings that are damaged.

If bearings are going to be reused, repack them with a high-temperature, multipurpose E.P. wheel-bearing grease. Use a bearing grease packer, if you have one.

Before installing bearings, clean old lubricant from the wheel-hub cavity and smear a small amount of fresh grease around the cavity. Discard the old grease seals for new ones.



Sparkplugs on rear bank of V6 X-cars are a chore to remove. They're also hard to see.

LUBRICATING THE CHASSIS

Model	Frequency (whichever occurs first)	Number and Locations of Grease Fittings
K-car	30,000 miles or three years.	Four. One on each suspension ball joint and one on the upper part of each tie rod.
E/L*		None. Sealed joints lubed for life.
X-body	7500 miles or 12 months.	Four. One on each suspension ball joint and one on the upper part of each tie rod.

REAR-WHEEL BEARING INSPECTION

Model	Frequency (whichever occurs first)
K-car	30,000 miles or three years.
E/L*	No scheduled maintenance (1).
X-body	No scheduled maintenance (2).

Footnotes: 1. No scheduled maintenance. Ford recommends that rear-wheel bearings be repacked with grease when rear brakes are relined.
2. No scheduled maintenance. X-body rear-wheel bearings are permanently lubricated.

AUTOMATIC TRANSAXLE MAINTENANCE

Model	Frequency
K-car	Check fluid level every 12 months or 7500 miles, whichever occurs first. (1)
E/L*	Check fluid level "occasionally." (2)
X-body	Check fluid level every 12 months or 7500 miles, whichever occurs first. Replace automatic transaxle fluid and service the filter every 100,000 miles if the car is used under normal driving conditions. (3)

Footnotes: 1. Under normal driving conditions, transaxle fluid and filter do not have to be changed nor bands adjusted. If the car is used in severe driving conditions, drain and change fluid (use Dexron II automatic transmission fluid), replace the filter and adjust bands every 15,000 miles. There is no drain plug. Draining fluid requires removing the transmission oilpan. Severe driving conditions are defined by Chrysler as operation of the K-car more than 50 percent of the time in heavy city traffic when the ambient temperature is about 90° F.

2. Under normal driving conditions, transaxle fluid does not have to be changed. If the car is used under severe driving conditions, drain and change fluid every 20 months or 20,000 miles, whichever occurs first. A drain plug is provided. Use Motorcraft automatic transmission fluid or Dexron II-Series D. (The filter and bands of the Escort and Lynx don't have to be serviced, even

when driving conditions are severe.) Severe driving conditions are defined by Ford as extended periods of idling or low-speed operation; using the car to tow a trailer; operation when the ambient temperature remains below 10° F. for 60 days or more and most trips are less than 10 miles; and operation under extreme dust conditions.

3. Under severe driving conditions, change fluid and service the filter every 15,000 miles. There is no drain plug. Draining fluid requires removing the transmission oilpan. Use Dexron II automatic transmission fluid. (Bands don't have to be adjusted even when driving conditions are severe.) Severe driving conditions are defined by GM as using the vehicle in heavy city traffic when ambient temperature "regularly" reaches 90° F.; in hilly or mountain areas; to pull a trailer, and for extended periods of idling and slow-speed operation.

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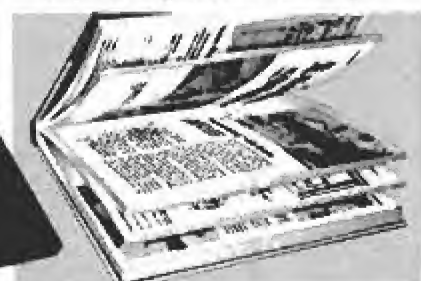
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Name

Address

City State Zip

HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Taming a rough ceiling

We built our house about four years ago. As several others in the neighborhood did, we had a rough blown-on finish put on the kitchen-dining room ceiling. We're looking for a solution to several problems with this finish:

1. It's impossible to clean this "moonscape" of grease and stains.
2. We'd like to subdue noise by adding a sound-deadening material.

Could we sand the high points level and glue acoustical ceiling tile in place? Does the tile need dead air space to work?—Mrs. D. Bresh, Wau-bay, S.D.

I paint my "moonscape" every three years, using a long-napped roller. If you want a smooth surface and an aid toward noise control, however, I suggest you investigate a ceiling material such as Armstrong's Fairmont Fashion Tone ceiling. This is a mineral-fiber, extra-washable, lay-in ceiling tile with an added coating of vinyl on its surface. The ceiling system alone is in the range of 35-40 STC (Sound Transmission Class). Flooring and carpeting above the area will raise the STC to a greater level.

The ½-in., 2×4-ft. tiles slip into a prehung ceiling grid. The dead air space between the tiles and the ceiling lessens noise coming from other areas and absorbs noise in the immediate area.

Although Armstrong recommends a drop of 3 in. for the grid system, I have installed this type of ceiling with a 2-in. clearance. Slide the tiles in carefully, starting from one end of the room.

If you can't locate this ceiling, write: Armstrong World Industries Inc., Box 3001, Lancaster, Pa. 17604 for the dealer nearest you.

Faucet dilemma

Our 18-unit condominium is about 6 years old. We all have Delta single-lever kitchen faucets, Series 100, 300 and so on. Only about half the faucets work properly, with adequate water pressure and flow. The other half exhibit little pressure and a very weak flow. Shutoff valves under the sink are clear, and the dishwasher and spray attachments on the same line work fine. We've checked the aerator to no avail. Why should some faucets work and some not?—Hermann P. Schlander, Pasadena, Calif.

Since the manufacturer enjoys an excellent reputation in its field, I suggest one more test before lowering the boom on Delta. Take a faucet that you know works properly and use it to replace one that doesn't work. If this one also doesn't work, then hardware isn't the problem.

You say that half work properly, so I assume that you've checked the aerator fitting for water-saving devices. If the nine or so families don't want to chip in the \$3 to \$4 for a plumber, write to: Delta Sales Corp., 2834 South Alameda St., Los Angeles, Calif. 90058. If, after your test, the faucets, and not the plumbing, appear to be at fault, ask a company representative to make an inspection.

Paint additive

For readers who are planning spring house painting, White Laboratories, Box 15355, Orlando, Fla.



Add ounce of X-14 Mildewcide to gallon of paint to give latter mildew resistance.

32858, has come out with an additive that can effectively make your paint mildew-resistant. The additive doesn't affect durability, drying process or color. Known as X-14 Mildew-

cide Paint Additive, it can be used with both latex and oil-base paints. It costs \$2 for a one-ounce bottle, which is enough to treat one gallon of paint. This and other X-14 products are available at hardware and paint stores. If you can't locate it, write to the above address for the dealer nearest you.

Treating wood shingles

The wood shingles on my 1-year-old house have never been treated. I live on the Gulf Coast in an area of high temperature and humidity. Is there any chemical treatment that I can apply to the shingles to prolong their life?—Kenneth J. Wiesman, Kinkwood, Tex.

Yes. In fact, the Red Cedar Shingle and Handsplit Shake Bureau, Bellevue, Wash. 98004, recommends shingle treatment.

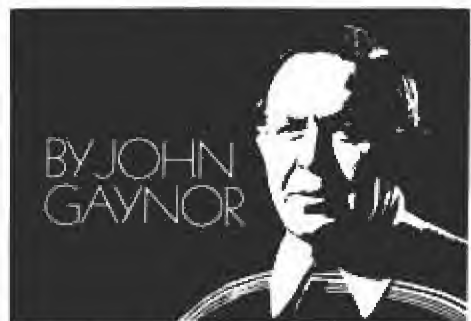
There are several preservatives on the market. One, called Woodlife, costs about \$11 per gallon and contains about five percent pentachlorophenol. It is only available in a clear finish, but may be painted or stained. If you can't locate the product, write Roberts Consolidated Industries, 600 North Baldwin Park Blvd., City of Industry, Calif. 91749, for a dealer near you.

Another product is Cuprinol. Cuprinol clear No. 20 wood preservative has a preservative known as zinc naphthenate. Cuprinol stained wood preservatives contain bis (tributyltin) oxide and folpet, which resists mildew. Cuprinol costs \$13 to \$16 per gallon. If you can't locate it, write to The Darworth Co., Box K, Avon, Conn. 06001.

Coverage for both Woodlife and Cuprinol is about 400 sq. ft. per gallon. Both may be sprayed or brushed on, but dipping prior to installation is ideal. These products are registered by the EPA.

Whichever you choose, wear goggles and gloves. Be sure to follow the instructions on the can. **PM**

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send order(s) to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.



GM

GMC
advertising
General
Motors



WITH A GMC, YOU DON'T TAKE YOUR LUMPS AT THE PUMPS.

NEW SUPER SAVER GMC PICKUP Like all the new GMC pickups, its styling is more aerodynamically efficient than last year's. In addition, our new Super Saver is powered by a thrifty 41 liter six and equipped with a manual 4-speed overdrive transmission, low numerical axle ratio and specially selected tires. All of which result in the gratifying EPA-estimated mileage shown

here. It is, we submit, a clear indication that you can drive a ½-ton GMC pickup that's built to do a full-size job without taking your lumps at the pumps.



30 EST.
HWY.

21 EPA EST.
MPG

REMEMBER: Compare the "estimated mpg" to the "estimated mpg" of other vehicles. You may get different mileage depending on how fast you drive, weather conditions and trip length. Actual highway mileage will probably be less than the estimated highway fuel economy. Super Saver Pickup not available in California.

GMC pickups are equipped with GM-built engines produced by various divisions. See your dealer for details.

TRUCKS ARE WHAT WE'RE ALL ABOUT.

AMERICA'S BEST-SELLING WAGON.*



That's quite a claim, isn't it? Especially when you consider the sizes, shapes and numbers wagons come in these days. So if you're going to be the best seller in a market that's as competitive as the wagon market, you'd better have a lot going for you. Rest assured, Fairmont does.

Just look at these mileage figures. Pretty impressive for a wagon. These numbers are for **34** EPA EST. HWY. **23** EPA EST. MPG comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage and California ratings will be lower.

Of course, room is what a wagon's all about. And Fairmont offers 79.5 cubic feet of

*Based on 1980 calendar year retail deliveries.

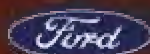
it. In fact, according to the EPA Interior Volume Index and manufacturer's suggested retail price, Fairmont offers more room for the money than any other wagon in America.

And here's the bottom line. Fairmont handles all this great mileage and room for a base sticker price that'll make it easy for you to handle a Fairmont.

When you add it all up, it's little wonder Fairmont's the best-selling wagon in America ... and very likely to remain so.

FORD FAIRMONT

FORD DIVISION



DETROIT LISTENING POST

Future GM engines

General Motors will introduce several new engines during the next three years, all designed for front-wheel-drive vehicles.

Oldsmobile is working on a five-cylinder diesel for '84-model cars, including all-new, transverse-engine Buick Rivieras, Olds Toronados and Cadillac Eldorados and Seviles. Olds also plans a new 90°, 3.2-liter, V6 diesel, adapted for transverse mounting in X-cars and the new fwd '82 A-body intermediates. Larger versions of this engine are likely to appear in 1983-84 fwd full-size cars.

Farther down the road, Olds is proposing V4 gas and diesel engines displacing 2.1 to 2.5 liters for J- and X-cars in '84 or later.

Chevy is said to be developing larger gas and diesel versions of the J-car's 1.8-liter, four-cylinder engine for use in '84 X-cars. GM's largest division also is heavily into development work on three-cylinder engines of 1.1 to 1.5 liters for GM's tiny, two-seat commuter cars, coming in three or four years.

Meanwhile, Buick indicates it will cut its existing 90° V6 in half to get three-cylinder blocks with displacements ranging from 1.3 to 2.1 liters.

Cadillac may drop its new aluminum block V8 program scheduled for '82, and instead introduce an aluminum V6 of 3.2 to 3.6 liters for its '83 fwd deVille and Brougham.

Pontiac is planning to downsize its 2.5-liter engine to 2.3 liters for possible use in '83-84 X- and J-cars. Also, there's a good chance this engine with throttle-body fuel injection will be mounted amidships in Pontiac's two-seat sports car (the P-car) due in '83.

Ford commuter cars for '84

Ford is developing high-mileage commuter cars under the code name "Optim." Reportedly, Ford has accelerated its plans for these lightweight two- and four-passenger commuter cars by two full years, from 1986 to 1984, in response to Pontiac's P-car project. A tiny, two-seat model on a wheelbase of about 72 inches will weigh only about 1300 pounds, while a four-seat version on a foot-longer wheelbase will weigh about 100 pounds more. That makes both of them considerably smaller than the P-car. A 0.9-liter, three-cyl-

inder and a 1.2-liter Four are the proposed Optim engines, and diesel versions of both are under consideration.

Sources say that Ford may drop the Granada, Fairmont or LTD in its '84 lineup because of the shift in market demand to smaller cars. All surviving Ford car lines should be fwd by 1985. Fairmont/Zephyr, Thunderbird/XR7 and Granada/Cougar are scheduled to make the switch by '83½, with the remaining larger cars following a year or two later.

Pontiac's changing image

One reason for manufacturing the P-car is to help Pontiac Div. achieve a new image. In the vast middle ground between Chevrolet and Cadillac, Pontiac must compete with Chevy on one end and both Olds and Buick on the other. Pontiac needs more than just good hardware to be successful—it needs a strong image in the public's mind.

Flamboyant general manager John DeLorean and his hot GTO helped move the division to third place in U.S. sales in the '60s. The early '70s, however, saw Pontiac's youthful, exciting image slip—and Oldsmobile passed it by in sales.

There was a resurgence of excitement (and sales) in the mid-'70s thanks to the sexy Firebird Trans Am's popularity.

But now, in the fuel-conscious '80s, that image hangs around the division's neck like an albatross. Many still see Pontiac as a maker of powerful, fuel-thirsty cars, and even once-stodgy Buick Div. has pulled ahead in sales and image.

So, Pontiac is trying to shed its long-nurtured brute performance image, leaving it with no image at all. Olds is known for diesel engines and its ever-popular Cutlass; Buick has the V6 engine and a new, youthful appeal. But Pontiac, with essentially the same hardware, is left peddling "More know-how to the gallon."

New general manager Bill Hoglund and his sharp, young chief engineer, Bob Dorn, are moving Pontiac in a new and exciting direction: eastward, toward Europe.

They're betting on BMW-type sport sedans and Fiat X1/9-like sports cars (the P-car) in the next couple of years. These will be followed by more European-style, fun,

but fuel-efficient, high-quality, high-technology machinery in years to come. "We ought to be a highly efficient, personal manufacturer of exciting cars," says Hoglund.

U.S. minitrucks for '82

Ford and GM will introduce new three-passenger minipickups this fall that will eventually replace their current Japanese models and lead to smaller 4wd vehicles and vans during the next decade.

A 1.8-liter, four-cylinder engine will be standard in '82 Chevy and GMC "S" trucks, and both a 1.8-liter diesel and a gas V6 will be optional. These trucks will be 2wd-only this fall, with 4wd coming a year later.

Ford's home-grown minitruck will feature a standard 2.3-liter, four-cylinder and, like its Chevy competition, will have a four-cylinder diesel and a gas V6 as options.

Buick Regal to pace '81 Indy

A 1981 Buick Regal with a much-modified 281-hp, 4.1-liter, V6 engine, reworked three-speed automatic transmission and special heavy-duty suspension and drive-train components will pace the 65th running of the Indy 500 race in May. A customized roof features an 8-inch roll bar directly behind removable hatch panels and a mini-convertible top that replaces the rear section.

Camaro/Firebird superseats

An exciting option for the all-new Camaro and Firebird due this fall will be a set of very sporty-looking, racing-type front bucket seats. Developed by the General Seating Div. of Lear Siegler Inc., they should cost less than competitors such as Recaro, yet still offer multiple adjustments, including lumbar, cushion bolster, height and recliner. **FM**



PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

State-of-the-art in fencing

U.S. Steel has published a manual, *How to Build Fences with USS Max-Ten 200 High-Tensile Fence Wire*. The 76-page manual gives advice on how to plan and build a nonelectric or an electrified high-tensile-wire fence to confine sheep, cattle, horses



Manual covers fence design and hardware.

and hogs or exclude predators. Max-Ten 200 fencing is single-strand, smooth, 12½-gauge galvanized wire. It's nearly twice as strong as 12½-gauge, two-ply barbed wire, according to U.S. Steel.

To order the manual, send your check or money order (\$6.50 postpaid), payable to United States Steel, noting the above title, to: Manager, Wire Products, U.S. Steel, Box 86-PM (A-618), Pittsburgh, Pa. 15230.—P.S.

Keep it clean

Make no mistake about it, paying a little bit of attention to your heating system can save you quite a few dollars. For most of us, that, in itself, is enough incentive for avoiding neglect.

Although oil-fired heating equipment will work when it's dirty, the Better Heating-Cooling Council advises that soot buildup on heat-transfer surfaces lowers the operating efficiency of the system. And the lower the efficiency, the more your fuel dollar goes up the chimney, says the Council.

The interior surfaces of your heating plant should be cleaned at least once a year. The same holds true for the flue pipe. The annual cleaning session is a good time to have your chimney inspected, and the heating equipment and controls checked. There are local companies that specialize in such work, using industrial vacuum cleaners and flue

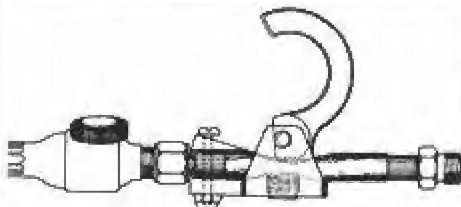
brushes. To find them, consult the classified phone directory under "Heating Contractors," "Boilers" or "Oils, Fuel."—H.W.

Hot attachment for welders

Save-a-Lite, a new welding torch attachment, is claimed to save 66 percent of torch-handling time. It eliminates needless readjustment of valves and allows quick, safe torch hang-up after use, according to its manufacturer.

It closes its own piece of welding hose, installed between the torch and the existing hose, by compressing it. When you push the handle forward, you return the torch to its previous setting—even in high winds. Pulling the handle back shuts off the torch and acts as a safety shutoff. You then use the handle to hang up the torch. The entire operation, which takes about five seconds, saves time, flint and gas.

The Save-a-Lite weighs only 2 oz.



Install Save-a-Lite with hang-up handle between the existing hose and torch head.

and fits all gas-cutting and welding torches. The \$34.50 postpaid price includes a 30-day, money-back guarantee from Save-a-Lite Corp., Box 1036, Dept. PM 381, Buffalo, Wyo. 82834. Write for the free brochure.

—H.W.

Add-on 'lumber mill'

With the Boyce lumber-mill attachments and a 3.5-hp chain saw (16-in. minimum bar length), you can cut usable lumber from logs. Since the tool is lightweight and easy to assemble, you can do your milling in the woods where you fell the tree. The rate of cutting is about 6 ft. per minute when ripping a 12-in.-dia. green pine log.

The complete mill (with adjust-



The adjustable guide bracket helps you to saw boards to the thickness you desire.

able and universal guide brackets, tip depth gauge and handle) costs just \$9 from O.D. Boyce, M.D., 406 South Chester St., Gastonia, N.C. 28052.

Rip chains and modified saw bars are also available at an additional cost. A mill-use manual is included with the unit.—J.R.P.

Label your small-parts jars

This set of five sheets of self-adhesive labels helps you identify containers for screws, nails and other small parts. The set contains 160 labels for 74 different items. An



Labels identify small-parts containers.

engraved brass nameplate is included with each order.

This useful shop aid is available from VB Enterprises, 807 East Dana, Mountain View, Calif. 94040. The price is \$4.95 postpaid.

—Rosario Capotosto

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

Jack-of-all-terrains.

And master of all. Town or toolies, it's all the same to our new TS dual-purpose bikes.

All four (TS-100, 125, 185, 250) come with street-legal lighting. Well-padded seats. And a quiet, smooth and gas-singy Power Reed™ engine.

So they're ideal for weekday commuting.

And each is equipped with long-travel suspension (including a rugged box-type swing arm), semi-knobby tires and motocross-styled pegs and grips. So they're ideal for weekend trail riding.

No matter where you take them, no need to worry about them. Their PEI ignition means no points to fiddle with. And their automatic "CCI"

oil injection system means no fussing with gas/oil mixtures.

In short, about all you have to do with these low-priced bikes is ride 'em. Anywhere.



Suzuki 1981



The Performer.

Always wear your seat belt. Please don't drink and drive. Always wear a helmet and proper riding apparel. Ride only where authorized and respect the environment.

PM LOOKS AT THREE NEW YARD TOOLS

The Cult-A-Eze garden cultivator is designed to simplify light gardening tasks. After two push-sessions behind it, I can report that it does just that.

The basic unit comes with a five-tine cultivator for working soil and removing weeds, a slicing hoe for cutting out new weeds and a plow. The plow is reversible, with a small end for shallow planting and a large end for deep planting. A moldboard plow for hilling, light plowing and deep furrowing is available as an optional accessory for \$8.45.

The attachments slide in and out of the clock-stop adapter. The unit works fine on soil that's in a workable state, but it's not intended for compacted or overgrown soil.

Model 6000-A is sold at garden supply centers, or is \$49.95 postpaid from Earthway Products Inc., Box 547-P, Bristol, Ind. 46507.

—Harry Wicks, *Home and Shop Editor*



Unlike other cultivators, the working part of this one is located between the wheels (above, right). Set desired cutting depth by turning adjustment handle (left).



Rake's tines are fully expanded to comb the lawn (photo, left). Adjusting tine expansion (right) is similar to operating an umbrella; here the rake is closed.

You can release or retract the tines of the A-Just-O-Rake to suit the job at hand. Simply loosen a wingnut and make the adjustment. A narrow span lets you rake in flower beds and around shrubs or rock gardens. Use a full expansion for general lawn cleanup. Adjust-O-Rake is priced at \$12.95 postpaid from Sharmil Associates, 36727 Saxony Rd., Farmington, Mich. 48024.—Rosario Capotosto

The Estate Mini Spreader for small farms and garden enthusiasts hooks up to a garden tractor for cleaning out and spreading manure. Small-size spreader's 36×36×48-in. bed is easy to load inside a barn. It's \$449 postpaid from Country Mfg. Inc., Fredericktown, Ohio 43019.

—Penelope Spangler



Mini Spreader has a 12-bushel capacity.



“You won’t believe you did it. But you did!”

—Homer Formby
3rd generation antique refinisher

Refinishing furniture used to mean stripping. A messy, time-consuming chore.

Homer Formby has changed all that.

With Homer Formby’s products, you’ll *never strip again*.

Imagine a system so simple, refinishing isn’t a drudgery, but an exciting project.

Imagine a system so foolproof, even your very first project looks professionally refinished in just half a day.

Refinishing.

From start to finish.

Pour some Furniture Refinisher into a metal tin, and dip your steel wool. (Use Formby’s steel wool, because it’s low in abrasion and oil content.) Now rub over a very small portion of your piece. There’s no need to rub hard! Very

quickly, you’ll see the old discolored varnish, lacquer and shellac melt away.

And the Furniture Refinisher does not raise the grain or destroy the patina, the way strippers do.

With Formby’s, you’re actually reaching back in time to the original finish by removing years of accumulated gunk.

After you’ve refinished, go over the piece one more time with clean Refinisher. By rubbing with the grain, you’ll remove any streaks or lap marks.

Now go over the piece with dry steel wool, to prepare the surface for Tung Oil.

Formby’s Tung Oil seals your furniture, because it actually penetrates the wood. Ordinary varnish merely sits on top. So when you hand-rub Formby’s Tung Oil, you’re not only repeating a centuries-old tradition, you’re also protecting that beautiful refinishing job.

And that’s all there is to it! No sanding, scraping or wood-filling.

Somewhere in your house is a piece of furniture you’ve never given a second thought. But underneath that beat-up exterior is a finish you can bring back to life.

And now is a great time to get started, because it’s National Furniture Refinishing Month. To celebrate, many of our dealers have a sale on Formby’s Refinisher. So don’t delay. Remember, you’ve got a prize right under your eyes.

For a free copy of Formby’s Furniture Fact Book, including tips on refinishing, staining and furniture care, write to Homer Formby, P.O. Box 647, Olive Branch, Mississippi 38654.

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Formby's®

No one knows wood, as good.
Formby's is a registered trademark of Formby's Inc.

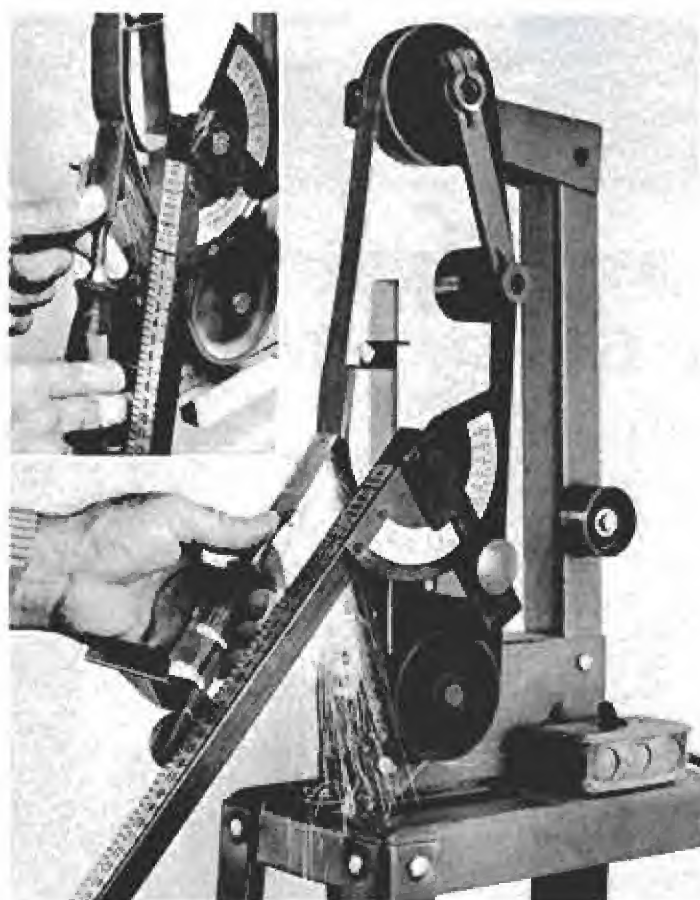
FORMBY'S PRODUCTS ARE AVAILABLE AT BETTER PAINT, HARDWARE, HOME CENTERS AND DEPARTMENT STORES.

PM experts test 5 new tools

Our staff experts and consultants test dozens of new tools every year. Findings on those that have merit are reported in these pages on a regular basis.

The comments on just how well a tool performs are based on its operation during actual workshop sessions, under on-the-job conditions, by PM craftsmen.

SANDER/GRINDER ACCESSORY



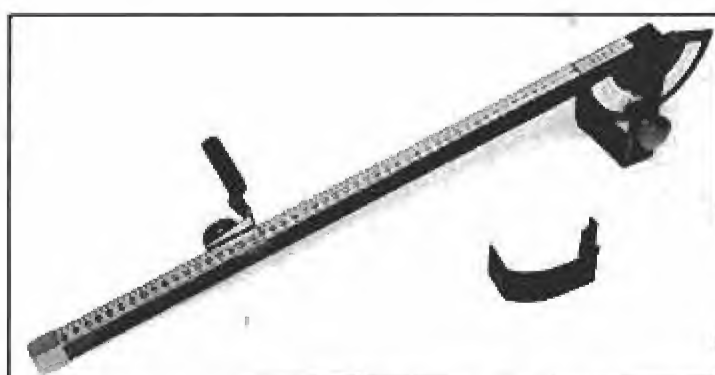
Edges on chisels, gouges, parting tools are easy to hone with accessory. Grind hollow bevels against platen curve (inset).

The ProEdge, a handy attachment for your sander/grinder, makes sharpening chores easier and helps to assure accurate results. It is particularly useful for sharpening those tools that have a curved cross section, since it allows you to rotate the tool on its axis while you are grinding.

The accessory consists of a special platen (metal plate which provides a hard backing for the grinding belt)

and an adjustable tool support. Both parts can be quickly attached to most sander/grinders. However, the unit will not fit models that are manufactured by Foley. Specify the make of tool you have when ordering the sharpening attachment.

The platen, against which the grinding belt rides, is shaped to allow both flat and hollow grinding. The tool support arm has a toolrest with a depression for centering tool



Accessory fits most sander/grinders. Specify model when ordering.



To assemble, mount bracket to pulley arbor (left). When stropping, point the cutting edge in direction of best movement (right).

handles. It can be adjusted to produce any degree of bevel desired. The conveniently indexed arm provides a means to regrind or touch up previously sharpened tools.

The ProEdge attachment is available from Prakto Inc., Box 1023, Birmingham, Mich. 48012, for \$49.95 postpaid. This includes six belts and lube wax. The stropping belt with compound is \$15 postpaid.

—Rosario Capotosto

POWER MITERBOX

Since my workshop is already equipped with a healthy 10-in. radial saw, I really questioned the value of adding a power miterbox to it. (A radial saw, of course, readily cuts miters.) After trying one out, though, I found that it's a welcome addition.

The saw is a precision tool that takes the frustration out of miter cutting. The angle-measuring scale on the machine is calibrated in half-degree increments, making it possible to cut a $\frac{1}{2}^\circ$ setting. To do so, you simply move the pivot arm so its center mark is between two $\frac{1}{2}^\circ$ graduations and lock it there.

The miter latch has detents at 0° , $22\frac{1}{2}^\circ$ and 45° , right and left (the most common miter angles). You swing the pivot arm to the desired angle detent and lock it in place by rotating the miter clamp knob.

Conclusions

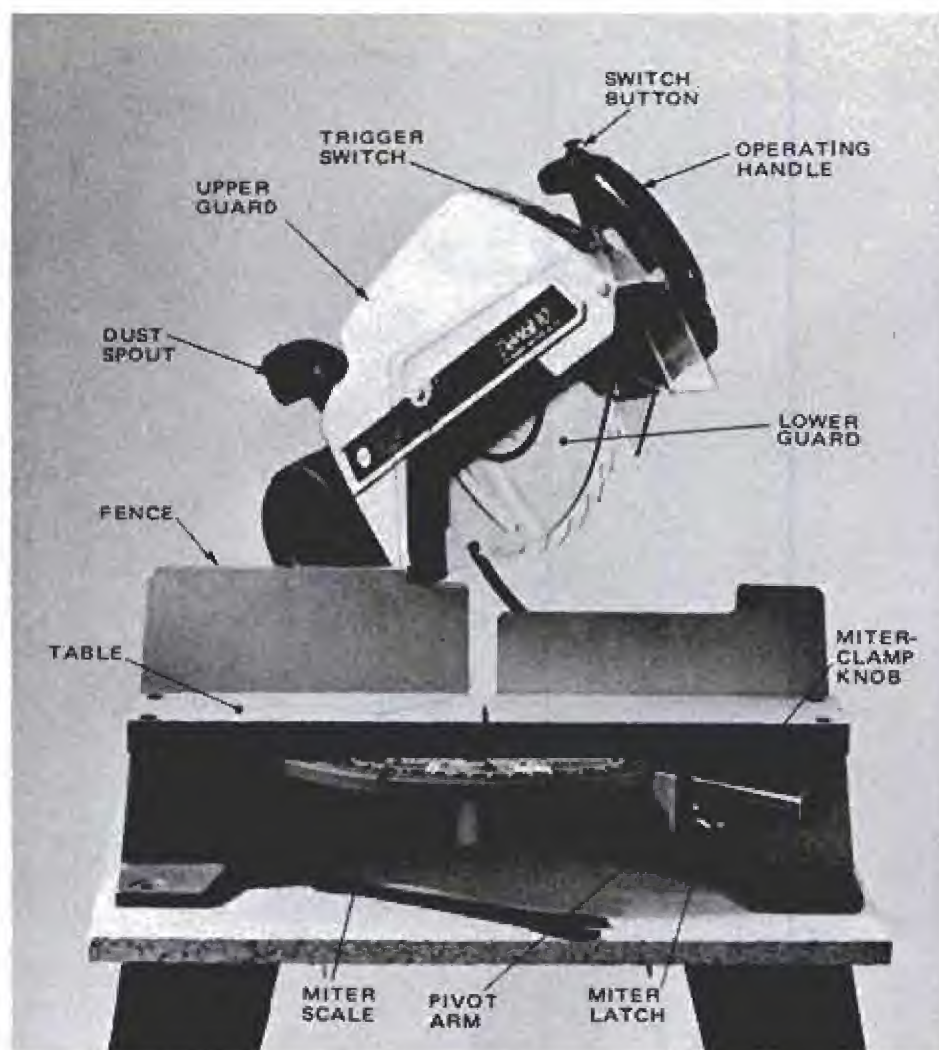
The power miterbox handles in craftsmanlike fashion. It's well made and, with reasonable care and attention, should give many years of first-rate service. The blade brake makes the tool extra safe; the blade stops almost immediately when trigger switch is released.

The tool is available at many hardware stores, home centers and lumberyards. If a local store doesn't stock it, it can probably order one for you; or write to the maker for a list of dealers near you.—*Harry Wicks, Home and Shop Editor*

(Please turn to page 52)

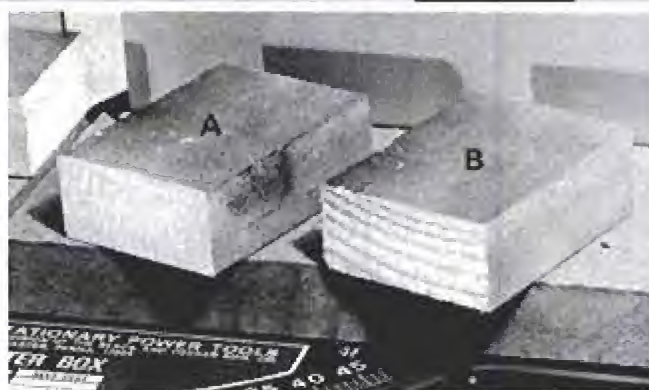
SPECIFICATIONS—POWER MITERBOX

Model: 7717
Motor: 10.5 amps., 120 v.a.c.
No-load blade speed: 5500 rpm
Blade: 10-in. diameter
Blade arbor: 5/8-in. diameter
Capacity: 3 5/8-in. height; 4 1/4-in. width
Positive miter stops: 0° , $22\frac{1}{2}^\circ$, 45° (right and left)
Cord length: 8 ft.
Weight: 34 lbs.
Price: About \$249
Manufacturer: DeWalt Div., Black & Decker Inc., 715 Fountain Ave., Box 4548, Lancaster, Pa. 17604



The DeWalt 10-in. power miterbox proved to be a highly accurate device.

The versatile miter saw can produce very smooth cuts (A) when you use a sharp combination blade and slow feed rate. For a fast, production-like job, you can switch to coarser blade with fast feed (B). The rough cut shown here was made with a heavy-set rip blade.



For easy cutting of crown and cove moldings, make the jig shown. First rip 45° spacers, mark the fence and bore for screws.

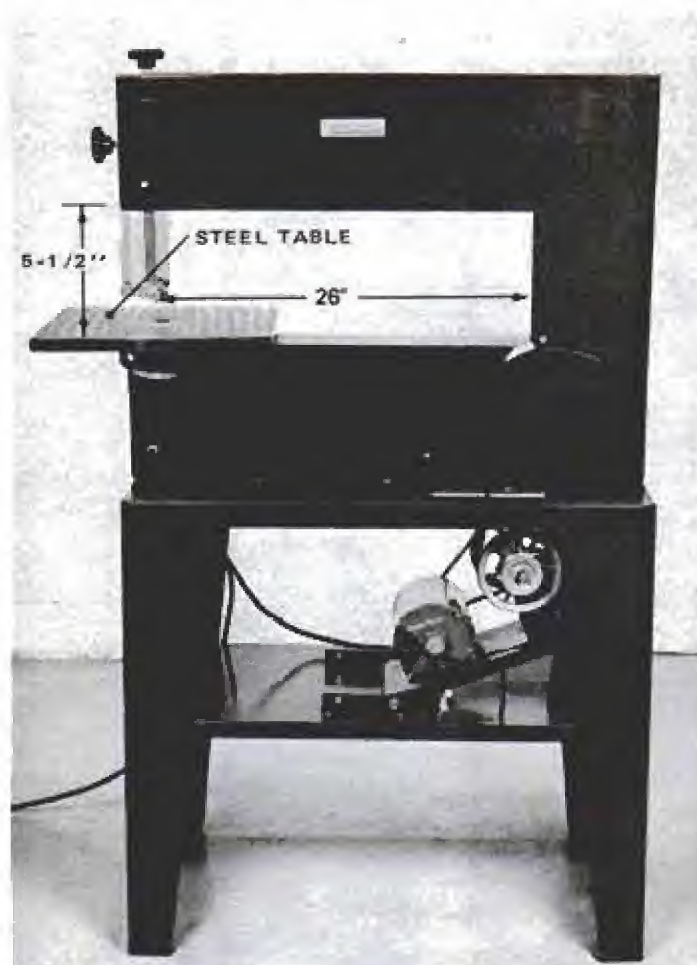


Next, use the cutoff from spacers and a clamp to hold the jig, while you install screws to hold the spacers to the fence.

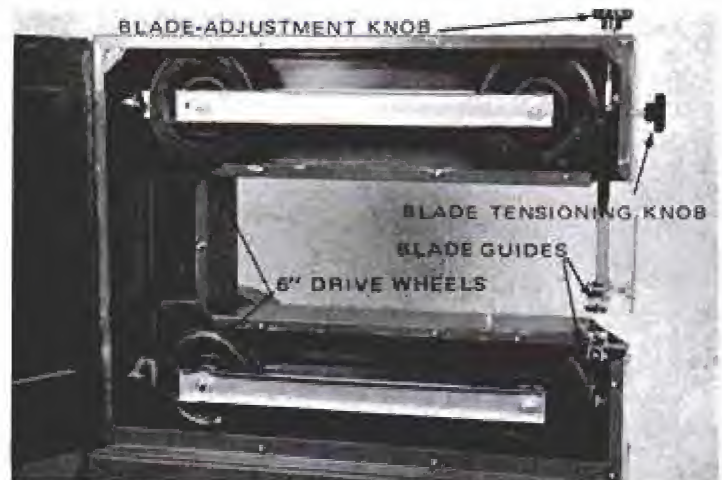


With both pieces in place, it's a snap to cut accurate, neat-looking miters on these otherwise tricky-to-cut moldings.

LARGE-CAPACITY BAND SAW



Unit can halve 4-ft. panels and cut out large, irregular shapes.



The unusual four-wheel design allows deeper throat than possible with two-wheel saws. Top knobs are for blade adjustments.



Fence (left), when used for resawing, allows no play to correct tracking once it's set. L-shape miter gauge rides the table edge.

A band saw really broadens your woodworking capabilities. But if you're setting up a shop on a tight budget, it is an unrealistic purchase. One economical alternative is a small portable band saw, such as the one we reviewed in September 1980 (*PM Looks at a Compact Band Saw*, page 101). If you have the space, however, a large-size, low-priced tool might suit you. Three features recommend the one shown here:

- It's a large-capacity unit.
- A six-pulley transmission system allows multiple operating speeds. You can change over quickly from speeds of 860 ft. per minute (fpm) for

cutting wood to 160 fpm for cutting metal and plastic.

- The price is right. This saw costs significantly less than saws of equivalent capacity.

There are compromises, however. I found the miter gauge, fence and blade guides awkward to use and adjust. The tilting table is not as rigid as that found on saws that have cast mounts. Finally, you must undo 14 wingnuts if the blade requires changing or rubber wheels need to be reattached.—*Joseph R. Provey*



Shop-made saw dolly improves stability by widening base and also provides shelf.

Note: Since our test, the manufacturer has informed us that a heavy-duty, cast table will be offered and that the miter gauge will ride in a groove. In addition, the housing door has been made easier and faster to open.

(Please turn to page 55)

DOLLY DETAIL

1-1/2 x 1-1/2 x 34"
(2 REQ.)
FASTEN WITH
NO. 10 x 2" FH
SCREWS AND GLUE

3/8" PLYWOOD,
SIZE TO FIT
INSIDE STAND
LEGS; FASTEN
WITH 6d FINISHING
NAILS AND GLUE

1-1/2 x 1-1/2 x 22"
(2 REQ.)

2" BED CASTER
(4 REQ.)
FASTEN WITH
NO. 8 x 1-1/2"
RH SCREWS

1/4"-DIA. BORE (4 PLACES)
BORE MATCHING HOLES IN STAND FEET
AND FASTEN WITH FOUR 1/4"-DIA. x 2"
CAPSCREWS, NUTS AND WASHERS

SPECIFICATIONS—B-26 BAND SAW

Throat: 26 in.
Depth of cut: 5 1/2 in. (6 in. with plastic guard removed)
Saw dimensions: 18 in. wide x 30 in. high x 36 in. long
Table construction: Reinforced sheet steel
Table size: 16 x 16 in.
Blade sizes: 1/8 to 1/2 in. x 109 in.
Drive wheels: 8-in. diameter
Price: \$364.90 for complete machine with stand, 1/2-hp motor,
\$49.95 for jackshaft reduction gear for metal cutting.
Shipping weight: 148 lbs.
Accessories: Table extension, B-241; miter gauge, B-242; rip
fence, B-243-H; stand, W-264 (welded) or B-264 (bolted).
Manufacturer: Du-ar Tools, 5448 Edina Industrial Blvd., Min-
neapolis, Minn. 55435

Why it costs less to spend a little more for a John Deere.

Granted, a John Deere Lawn Tractor, Rider or Walk-Behind Mower may cost a little more than some others you might consider buying. At first, anyway.

But in the long run, you almost always save money buying a John Deere.

Take lawn tractors. On the average, the life span of a "bargain" lawn tractor is four to five years, depending on brand and use.

And the John Deere line of 21-inch walk-behind mowers, though introduced only a few years ago, is just as solid and dependable as the others.

Look at it this way. Which would you rather have? A John Deere Lawn Tractor that may well last 12 years? Or a "bargain" tractor that lasts only four or five?

Figure it out and you'll see why it costs less to spend a little more for a John Deere.

By contrast, it is not at all unusual for a John Deere to last 10 years or more.

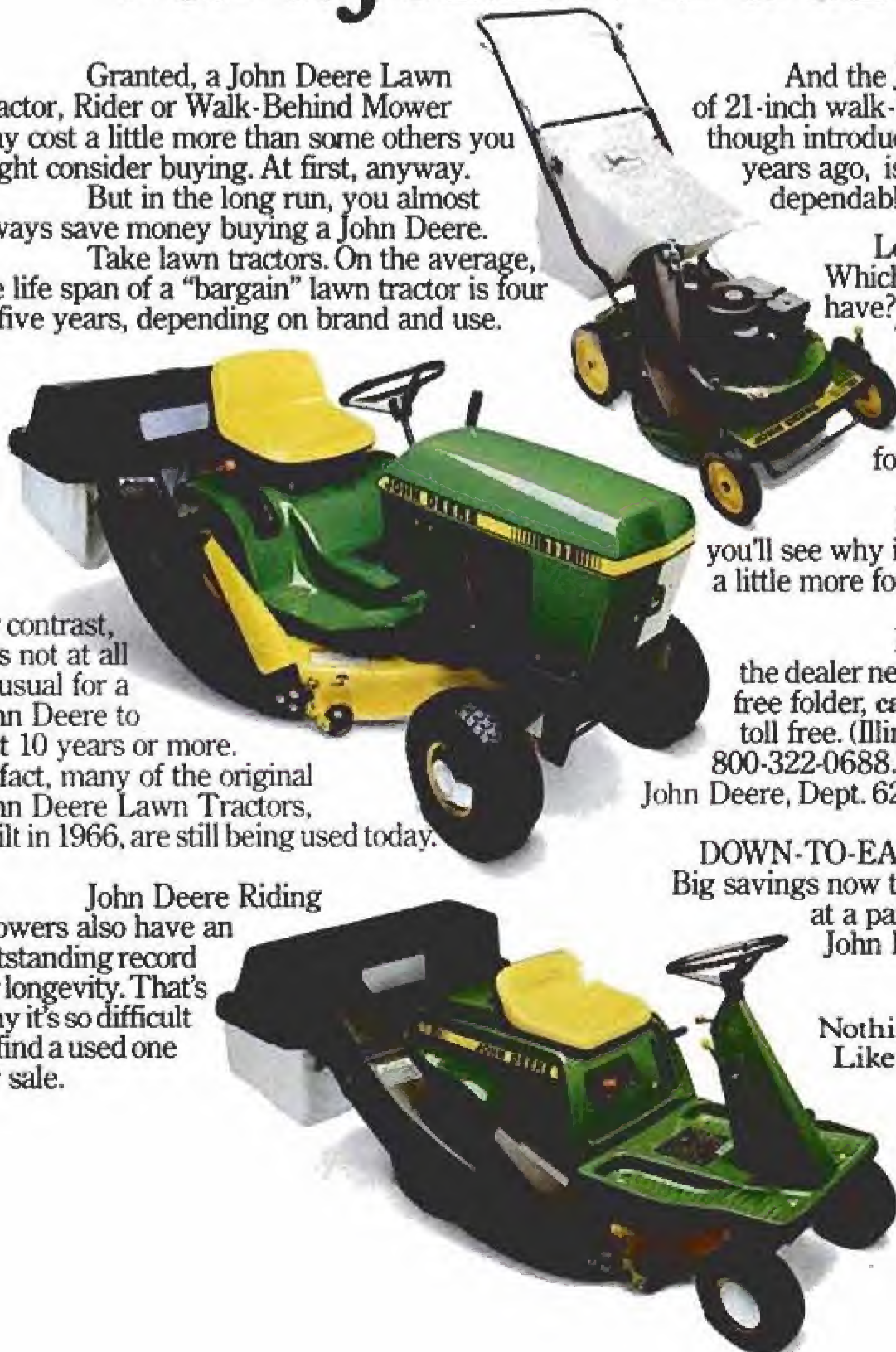
In fact, many of the original John Deere Lawn Tractors, built in 1966, are still being used today.

For the name of the dealer nearest you, or a free folder, call 800-447-0606, toll free. (Illinois, call 800-322-0688.) Or write John Deere, Dept. 62, Moline, IL 61265.

DOWN-TO-EARTH VALUE.
Big savings now through May 31 at a participating John Deere dealer.

John Deere Riding Mowers also have an outstanding record for longevity. That's why it's so difficult to find a used one for sale.

Nothing Runs
Like a Deere®



FIRST TIME EVER! BEST EPA RATING EVER! AND CHEVY'S GOT IT! 20 MPG. V8 POWER.



Chevy V8 Special Economy Truck

BEST EPA ESTIMATED GAS MILEAGE RATING OF ANY V8 TRUCK EVER! EVEN BETTER THAN ANY V8 CAR, IMPORTED OR DOMESTIC!

Here are some surprising facts:

FACT: In the past 5 model years, over 80% of all domestic light-duty trucks were equipped with V8 engines!

FACT: In V8 power and economy, Chevy V8 Special Economy Truck beats its closest sales competitor's highest-mileage V8 by 3 miles per gallon and 47 horsepower!

FACT: Chevy V8 Special Economy Truck combines the power of a V8 with the economy of a Six!

FACT: Chevy Special Economy Truck has the best EPA estimated MPG of any V8 truck... even better than any V8 car, import or domestic!

FACT: Chevy Special Economy Truck is not only surprising—it's amazing!

28 EST.
HWY.

20 EPA
EST.
MPG
(CITY)

Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Mileage will be less in heavy city traffic. Actual highway mileage lower. Not available in California where com-

parisons do not apply.

Fuel economy comparisons exclude trucks with same powertrains offered by GMC Truck Division.

Chevy pickups are equipped with GM-built engines produced by various divisions. See your dealer for details.

See a limited production Chevy V8 Special Economy Truck today.



DO-IT-YOURSELF'S WELDER

If you're in the market for a medium-duty gas welding outfit, this kit will meet your needs. The regulators will operate on acetylene, MAPP gas or propane. You simply provide the proper fitting for the fuel-gas cylinder inlet.

The torch performed nicely when used for brazing a repair piece to a car fender. It also cut through a 2-in.

piece of angle iron in about 15 seconds. The lightweight, well-balanced torch was easy to handle. If I were to make any changes, I would opt for a 20-foot hose instead of the

12½-footer that was supplied. The instruction manual was a little sparse and could use an overhaul.

—Bob Berger



Using the No. 2 tip, the torch makes short work of a brazing job on a car fender.



Kit has torch, two single-stage regulators with gauges, welding tips, cutting attachment, hose, goggles, lighter, manual.

SPECIFICATIONS—WELDER

Model: Aircor 8

Welding capacity: Up to ¾ in. with optional tips

Cutting capacity: Up to 2½ in. with optional tips

Welding tips: Nos. 0 and 2; optional tips Nos. 00-7

Optional accessories: Circle-burning attachment; heating tips; roller-guide attachment

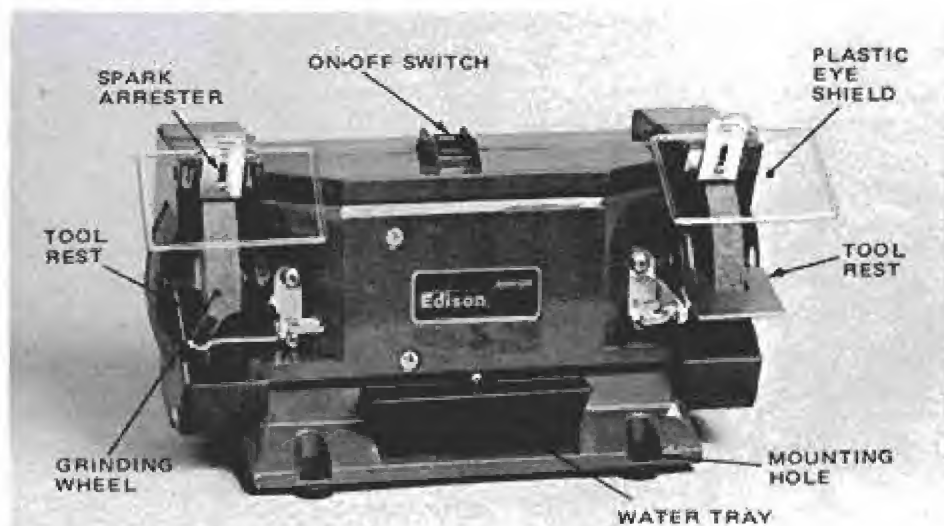
Price: Approximately \$200

Manufacturer: Aircor Welding Products, 575 Mountain Ave., Murray Hill, N.J. 07974



The corn-cob-patterned handle effectively keeps torch from turning in gloved hand.

BENCH GRINDER



The 6-in. bench grinder has two wheel stations, comes with a built-in electric motor.



Sharpen worn twist drill bit while holding it in the toolrest groove for guidance.



Square screwdriver tip after reshaping blade by holding on rest, touching wheel.

I recently tested a steady, fairly quiet bench grinder and found it handy for typical household grinding tasks.

The grinder is effective for sharpening various tools and, when used with a wire wheel, for cleaning rust off garden tools.

The toolrests adjust easily or they can be removed to obtain proper bevels or access to the wheels. Safety features include a spark arrester and eye-shield assembly. Fenders, which enclose about two-thirds of both wheels, minimize the danger of a shattering wheel.

—Joseph R. Provey

SPECIFICATIONS—BENCH GRINDER

Model: 6-in., No. T 660216-A

Housing: Die-cast aluminum

Weight: 22¼ lbs.

Speed: 3450 rpm

Electric: 115 v.a.c.; 8 amps.; UL-listed

Grinding wheels: Fine and coarse (included)

Price: \$80

Manufacturer: BenchMark Tool Co., 2601 Industrial Dr., Jefferson City, Mo. 65101



Convenient water tray allows frequent quenching to prevent loss of tool temper.

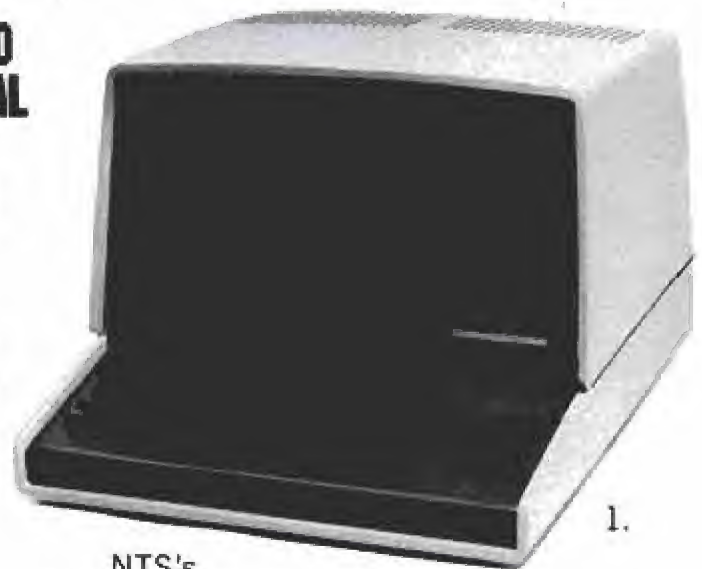
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1.

NTS's Master Course in Microcomputers includes the NTS/HEATH H-89 Microcomputer (#1 above). It features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory expandable to 48K. HDOS included.

The NTS/Rockwell AIM 65 Microcomputer (#2) is included in our Microprocessor Technology Course. It's a single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. This 6502-based unit also has 4K RAM memory, expandable, 8K monitor ROM and 8K advanced BASIC interpreter on ROM.

And in NTS's Master Course in Electronics and Industrial Technology, you'll work with the NTS/KIM-1 Microcomputer (#3). This unit features a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. It's a 6502-based microcomputer with 1K of RAM memory, expandable.



2.



3.

for you to learn BASIC high level language programming and assembly language programming.

It's also important to note that our microcomputers are not home-made training devices. They are production model micro-systems, identical to many you'll encounter in the field. We believe this makes your training a lot more exciting and relevant.

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AUTO MECHANICS Few technical fields can offer the challenges and opportunities that the auto industry can. To train for it with NTS, you'll utilize "shop-tested" instruction plus an impressive array of professional equipment, including a solid-state automotive oscilloscope. You'll learn engine diagnosis, motor overhaul, transmissions and much, much more.



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essential industries in the world. Learn servicing of commercial, industrial and residential heating and cooling equipment. Your course includes such equipment as a hermetic unit analyzer, leak detector and charging-testing-purging manifold set.



HOME APPLIANCES. Here's an excellent full or part time opportunity with real potential. Saves you money on your own repairs, too! Course covers repair and servicing of washers, dryers, ranges and small appliances. Your equipment will include NTS's amazing circuit trainer plus a multimeter for testing purposes.

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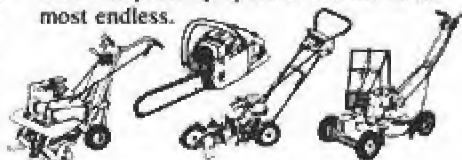
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PANASONIC RS-J3

by Ivan Berger

When stereo first came out, people worried about how they'd fit it into their living rooms. Now you can walk around with stereo in your pocket.

What's the secret? Headphones—all-new, ultralight, ultracompact phones that you can carry or wear all day.

Headphones have four advantages in making stereo smaller. Where speakers must be spread apart to give a stereo effect, headphones require just the distance between your ears to provide stereophonic sound. Even tiny head-

phones can provide a full range of frequencies, while speakers must be reasonably big to deliver low bass tones. Headphones don't need to pump out high volumes, either, since they transmit directly to the ear—so both the phones and the amplifiers that drive them can be small.

Another advantage of headphones is the privacy they allow: You can listen without disturbing others.

Sony's Walkman, the first of the pocket stereos, is a cassette deck that incorporates a microphone and a button marked Hot Line. Press the button and the microphone switches

on so you can hear the real world around you, while the music drops to background level. (That's all the microphone does, though. These stereo portables are strictly players, not recorders. The exceptions to this are the Sony and Aiwa recorders, discussed on page 185. On these, however, the mikes are strictly for recording, not for listening.)

If you've noticed lots of people wearing miniature headphones on the street, the Walkman is responsible—though not all of those phones are plugged into Walkmans. By now, there are at least a dozen pocket ste-

(Please turn to page 66)

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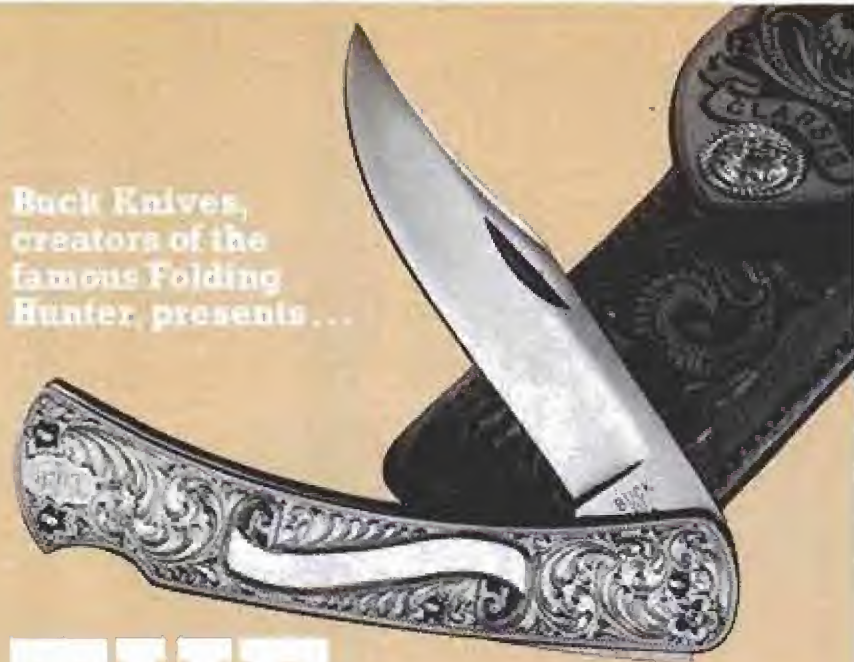
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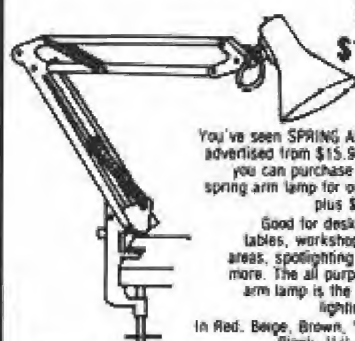


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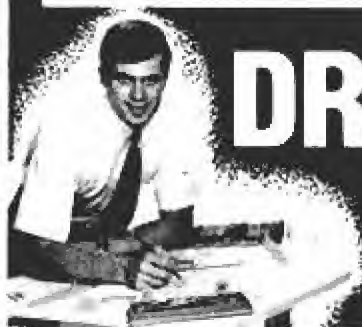
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Even when it's carried in your shirt pocket, Sony's SRF-80W is easy to work. Everything you need to reach is on top. Tiny tuning control is very sensitive vernier for accurate tuning.



reo tape players.

The original Walkman (\$200) set the pattern for pocket stereo players. In addition to the Hot Line, it features dual volume controls (for stereo balance adjustment), dual headphone jacks (so you can listen with a friend), and a two-position, switchable tone control. Including batteries, it weighs less than a pound. It comes with a pair of stereo headphones and a carrying case with a shoulder strap and belt loop. There's also an input jack for optional power supplies to run the Walkman from house current or car batteries.

We tried the Walkman along with six other players, two pocket recorders and a pocket stereo radio. The six cassette players followed the Walkman's pattern, with the following differences.

Audiologic by Randix, the largest and heaviest of the lot, weighs 23 ounces. It has a keyboard similar to that found on table decks, instead of the buttons on most portables. It has only a single volume control, with no balance adjustment, but it does have a continuous tone control. List price is about \$160.



Pop-in FM tuner fits the cassette holder of Toshiba's KT-S2. Unique design allows tape player to become a stereo radio.

General Electric Stereo Escape (\$130): Another heavyweight (20 ounces with batteries), it features a detachable belt clip that can hold the unit vertically or horizontally. Instead of a listen switch, it has a Mute, which simply turns the music down—there's no mike.

Panasonic RS-J3 (\$150) has only one headphone jack, but it has two RCA jacks to feed a signal into your hi-fi system. A light shows when the microphone is on. It's 21 ounces.

Sanyo 5550 Sportster (\$200) has lots of features. The microphone has both the Walkman-type listen mode and a "mix" mode. On the latter setting, the music maintains its previous volume, but the mike is live, so you can sing along and hear your voice in the headphones. There's also a pitch control, which varies the tape's speed slightly. The most convenient feature is the AMSS music finder. This automatically stops the tape in the fast-forward or rewind mode at gaps between musical selections. This allows you to repeat or skip tunes without hunting for them. (It also stops at quiet musical passages, a minor nuisance.)

Technidyne Hip-Pocket Stereo (\$150) is similar to the Walkman, with less convenient controls.

Toshiba KT-S2 (\$200) is just under a pound. It squeaks a half ounce past the pound mark if you add its most distinguishing feature: an FM stereo tuner built into a cassette shell. The tape-compartment lid is slotted for easy access to the tuning control, and the tuner also has a stereo/mono switch and a stereo indicator light. The tape deck has just one headphone jack. However, it has two tone switches, and an equalization switch for playback of regular or CrO₂ and metal tapes.

(Please turn to page 100)

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I reported this to some of my readers. And told them where they could get some of these.*

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"**WOW!** Have you ever got something here? I have already put \$35,000 where my mouth is. I look forward to the day when I can thank you personally.

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• **It should get more profitable for you AUTOMATICALLY.** As word spreads about this, the more profitable it should become to you. Yes, *automatically!* You'll see why when you read this Report.

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In this Report I'll reveal to you someone right in your own area who can prove the value of this to you. Yes, a reference right near you—whom you can call the very day you receive this!

Have you ever heard of anything like that before?

• **Think about it for a moment—a reference you can call right near you, no matter where in the world you live . . . Who can prove the value of this to you . . .**

If I can make such an incredible guarantee—and send you this Report absolutely free to boot—isn't this something you owe to yourself to see?

No, I can't promise you'll make a fortune from this or even as much money as others are. But I can tell you this: No matter where you are, no matter what you now do — *I think you're about to find this the best way to enrich your life you will ever see . . .*

Here's all you have to do:

1. Send for this shocking Report today. Remember, it's yours absolutely free.

2. Read it as soon as it arrives. See how easily you can profit from it.

3. If you have any questions, call any person whose name and telephone number appears in this Report. See what he or she tells you about this.

4. Then, put it to work for YOU!

It's as simple as that.

A prominent publisher said this dynamite 10 page Report was so valuable I should sell it for \$20.00. But, as I promised, it's yours free. That's right, no cost, no obligation whatsoever.

WHY AM I SENDING YOU THIS ABSOLUTELY FREE?

Because once you read this and see for yourself how valuable this is, I think you'll want to get anything I ever write again.

But more than that . . . For fifteen years I've been writing my financial column, hearing people say I uncover the best new ways to make money they've ever seen. Now, this discovery, I believe, will prove it. That's why I'm sending you this startling Report free — *to prove it!*

There are dozens of books you can buy telling you how to make money—costing \$10, \$20, even more. But I believe you'll find this One Report more valuable than any of them. That's right, more valuable than anything you can buy . . .

And I promise you: You will never be asked to pay one cent for this—now or ever.

Your copy is waiting here for you.

Wait until you see it. I think it will change your life.

The rest, my friend, is up to you.

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(Because of the importance of this Report, it will be sent to you by immediate airmail/first class shipment!)

Name

Street

City State Zip

Alan Shawn Feinstein's financial column, *The Treasure Chest*, is syndicated in newspapers in Europe, Africa and Asia as well as throughout the U.S. He is listed in "Who's Who in the East" and "International Men of Achievement."

*IMPORTANT—We've received word that the Japanese are now trying to buy up all of these they can find! We urge you to get this Report as soon as possible.

ALL OUTDOORS

Water under the bridge

The problems of leading a boat to water, or getting there yourself for fun and fishing, may be simplified by a new program from the U.S. Heritage and Conservation Service (HCS).

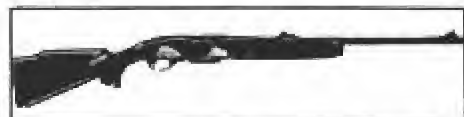
Each year more people have had more trouble finding public roads that lead to public launching ramps. Now the HCS will make funds available for building ramps close to bridges on main roads. All states have to do is make application for new ramps in areas adjacent to bridges under construction, replacement or repair. The projects seem like an ideal way to help relieve water-access congestion.

Improving a winner

New from Remington are updated models of two not-so-old favorites. They are called the Model Four autoloader and the Model Six pump action. Both provide these convenient actions in high-powered rifle calibers.

The Model Four is replacing the Model 742 of 1960, the improved version of the 740 that was considered the first autoloader capable of handling powerful big-game cartridges like the 30/06. The Model Six pump takes the place of the 760, with a history going back to the Model 14 pump-action, center-fire of 1912.

Longer life, smoother action and



Remington Model Four auto takes 30/06.



New 7600, like Model Six, is pump rifle.

stronger lockup are among the major improvements claimed. Both can handle 243 Winchester, 6-mm Remington, 270 and 308 Winchester, and 30/06 cartridges. Both weigh 7½ pounds and can fire five shots as fast as you can pump the Six or pull the trigger of the Four. With Monte Carlo comb and cheek-piece butt stocks, the Model Four is \$450; the Six, \$400. Less expensive straight-comb stock models are called the 7400 for the auto, 7600 for the pump, and cost \$50 less.

Home from the road

One of the many reasons recreational vehicles will remain popular is the view they give of the country. When fuel prices go up and the economy goes down, RV sales slow down somewhat, but they haven't slumped as much as expected. Couples at retirement age still find a motor home or travel trailer the ideal way to visit the spots they've always wanted to see.

Frequently, this means selling the house, putting possessions in storage and hitting the road. But along the way, the travelers often find a pleasant new place to winter in the



A vacation shelter/home with utilities in the trailer, new Freemor Mark 1 is versatile.

South or spend the summer in the North, and it would be fun to have room for belongings and a workshop, perhaps, plus more space when the kids come to visit. Outdoorsmen with a basic vacation cabin could also use the conveniences of their RV for bathroom and kitchen.

About seven years ago, we showed *Popular Mechanics'* answer—RV *Home Away from Home* (page 138, June '74). It was an idea house with an adjoining garage that housed a motor home attached to a side entry with an accordion passageway. The initial room could be expanded to add bedrooms, kitchen and bath. A number of readers wrote us to say they wished we had detailed plans.

Now two companies have teamed up to put the concept into practice. Freemor Homes, Box 6424, Pittsburgh, Pa. 15212, has developed plans for several different models, and construction is already underway in Arizona, Florida and Pennsylvania. Yellowstone Trailers, 28163 Country Road 20W, Elkhart, Ind. 46514, provides a 22-foot YF-7 trailer, especially built to fit the Freemor Homes as a kitchen-bathroom utility center. On the road, it sleeps two and serves as a regular travel trailer, though it has a full-size bathtub and options for washer-

dryer and storm windows, as well.

The lower cost could make possible RV-houses in several parts of the country for people who like a mix of on-the-go and stay-at-home living, and want to fulfill PM's original suggestion for the best possible of both worlds.

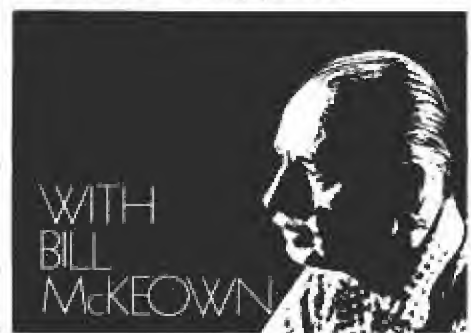
Getting feet wet

For sportsmen planning to go afloat this year, there are a number of new books and booklets and some updated older ones. The boat most economical of fossil fuel, of course, is the one that doesn't use any—the sailboat. A booklet, *Sailboat Buying*, gives tips to help a first-timer figure how he can afford one.

How to make the new boat go is learned through instruction and practice, and lessons can be located with *Where to Learn to Sail*, another booklet prepared by the National Marine Manufacturers Assn. (NMMA). It covers classes for beginners, plus the more advanced skills of navigation, racing, multihull handling and cruising. School locations may be as near as your home town, and as pleasant as the Caribbean. Both booklets are available free from the NMMA, 666 Third Ave., New York, N.Y. 10017. *Facts and Fun of Boat Buying* and *A Guide to Fuel Efficient Boating* are at Mercruiser sterndrive dealers.

A classic instruction book that covers all the skills of the sport is Chapman's *Piloting, Seamanship & Small Boat Handling*. It's now in its 54th edition at bookstores or from Hearst Books, Dept. MB-75, Box 983, Hicksville, N.Y. 11802, for \$14.95.

And for turning a hobby into a profession, the Florida Institute of Technology has opened a school for outboard-motor technicians in Jensen Beach, Fla. on the Intra Coastal Waterway. Named the Ralph Evinrude School of Marine Technology, it now covers all makes of outboards, and is expected to expand into stern-drives and diesels, as well. **PM**



All These Sell-On-Sight Moneymakers Can Be Made With Just One Tool!

Picture yourself turning out hand crafted things like these — and selling them for a profit!

It's easier than you think. You can enjoy hours of pleasure and relaxation making beautiful, useful items from salad bowls to lamp bases. Then, as a bonus reward from your leisure, you can see these things sell — as fast as you make them.

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You may have thought it takes too much costly equipment to turn out this kind of professional-looking work. But you're wrong. You no longer need to spend a fortune or clutter your limited workshop space with dozens of cumbersome tools.

Now, there is one unique power tool so versatile, so high in quality, and so easy to use that it's all you need to create instant best sellers.

This remarkable machine is the Shopsmith MARK V. It is so amazingly compact that it takes no more space than a bicycle. But it **outperforms** any combination of power tools you can buy.

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**The Shopsmith MARK V —
the tool to start with . . .
the system you grow with!**



Each tool is powered by the same rugged heavy duty, precision-built motor so the MARK V costs you far less than five individual tools.

It's easy to make sell-on-sight items with the one tool that's right for all your jobs! The Shopsmith MARK V is versatile and easy to operate. After only an hour's practice, you'll find yourself changing operations from setup to setup in less than 90 seconds. You'll also find yourself moving into tricky, complicated jobs you wouldn't dream of tackling now. They're easy with the MARK V — **the skills you need are built into the machine.**

What's more, you'll be able to "borrow" functions and setups from one tool to enhance the capabilities of the other tools. And you can add accessory tools and functions later as you need them. So your MARK V can grow right along with your woodworking business . . .

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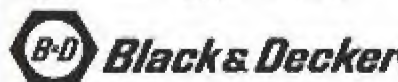


PHOTO HINTS

A dodging funnel



An ordinary 16-ounce funnel makes an excellent dodging device to "burn in" small areas of a print. Red plastic can be used as is; transparent ones must be lined with paper.—*Robert Hertzberg*

Touchup sticks



One of the best, most convenient and least costly spotting colors you can buy is an ink stick. Intended for calligraphy, it's sold at art stores.—*Bob Berger*

Get that lint out



When lint or other specks fall into trays or tanks, remove them with an inexpensive, plastic egg separator.—*Parry C. Yob*

Bags to cushions

Tuck one or two plastic sandwich bags and ties into your gadget bag. When you need a camera rest for a long exposure, fill a bag with sand, soil or other loose material. Place the cushion on a solid surface and mold it to support the camera.—*Wayne Fugate*

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FORTY-NINER'S PEPPERBOX PISTOL

(Continued from page 27)



An attractive decorating piece that hints of the California Gold Rush days, this pepperbox pistol is a reproduction of models made in Massachusetts by Ethan Allen circa 1845. You can duplicate the pistol with two pieces of wood and simple hardware.

Contrary to popular belief, the most popular handgun of the 1849 California gold rush was not the Colt revolver, but the pepperbox pistol. This was a firearm with three or more barrels encircling a central axis. It fired shots successively with only one striker.

The most popular American pepperboxes were the cap-and-ball weapons made by Ethan Allen between 1837 and 1865.

The reproduction shown is of a small .28-cal., five-shot, 3-in.-long barrel pepperbox made about 1845. Begin work by ruling a block of pine into $\frac{1}{2}$ -in. squares and transferring the grip pattern (B) to it. Cut out the grip. Draw a centerline around it to help you keep the model symmetrical. Round the grip to an oval cross section, always taking care to whittle across the end of the grain, rather than into it, to avoid splitting. Then cut the shallow grooves around the grips. Rough-sand with 80-grit sandpaper, dust and wipe with a tack cloth. Add simple engravings to each side of the frame if you wish. Allen's engravers didn't use a specific pattern for their designs, so simply use a pattern of scrolls similar to the ones illustrated. Final-sand with 100- or 120-grit sandpaper, dust, and tack off.

Add the flathead grip screws to each side and also add the round-head trigger tension screw to the front of the butt.

Cut the barrel cluster (A) of 1-in.-dia. round (dowel). Shape the end that attaches to the grip by diminishing its diameter. Using a $\frac{5}{16}$ -in.-dia. bit, make the five bores at the front about $\frac{1}{2}$ -in. deep. Then use a gouge to form the flutes between the barrels.

Next, carefully rough and final-sand the barrel with the grain, rounding off the edges of the flutes. Turn in the barrel screw. Glue the barrel cluster into position on the front of the grip; be sure that one of the bores is at the top.

Cut out the trigger (E) and the two parts of the hammer (C, D). Round the nose of the hammer to shape and reduce the thickness of the trigger and the blade of the hammer to $\frac{3}{16}$ -in.

Rough and final-sand both carefully and glue into place, taking care to fit the two parts of the hammer properly.

Bore a hole in one end of the metal strip (F) and bend the strip into shape for the trigger guard so that the hole is in the rear. Attach the trigger guard to the grip.

To finish the gun, remove all screws except the one on the trigger guard. Treat the grips to two coats of a walnut stain, let dry, go over them lightly with 180-grit sandpaper and finish with tung oil. Paint all metal parts with gun-metal-blue paint (made by mixing equal parts of light blue and black enamel).

When the paint is completely dry, cut the gloss by rubbing with $\frac{4}{0}$ steel wool; reassemble the pistol.

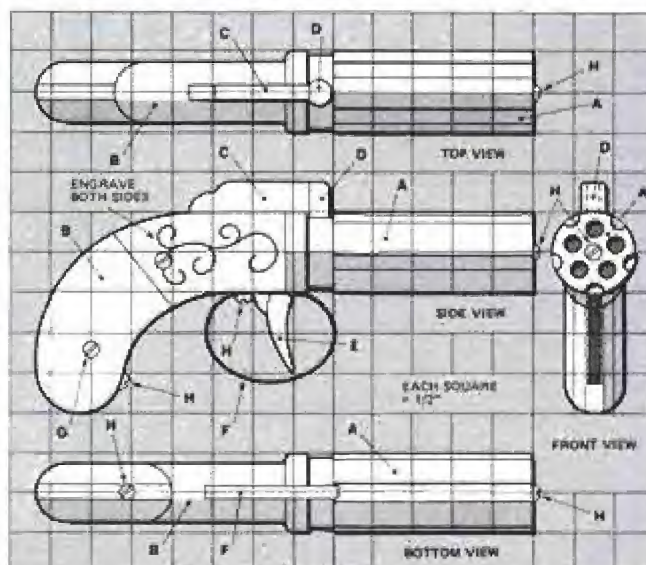
—Richard L. Coulton

(Please turn to page 74)

MATERIALS LIST—FORTY-NINER'S PEPPERBOX PISTOL

Key	No.	Size and description (use)
A	1	1"-dia. x $3\frac{1}{4}$ " pine round (barrel cluster)
B	1	$\frac{3}{4}$ x $2\frac{1}{2}$ x 3" pine (grip)
C	1	$\frac{3}{4}$ x $2\frac{1}{2}$ x 3" pine (hammer blade)
D	1	$\frac{3}{4}$ x $2\frac{1}{2}$ x 3" pine (hammer nose)
E	1	$\frac{3}{4}$ x $2\frac{1}{2}$ x 3" pine (trigger)
F	1	$\frac{1}{4}$ x $4\frac{1}{4}$ " metal strip; tin-can scrap
G	4	$\frac{1}{4}$ "-dia. x $\frac{3}{8}$ " rh wood screws
H	3	$\frac{1}{4}$ "-dia. x $\frac{3}{8}$ " rh wood screws

Misc.: Glue, walnut stain, tung oil, light blue and black enamel or metal paints.



Only factory original Briggs & Stratton parts will give you factory original Briggs & Stratton engine performance.



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Substitute parts can cost you a lot more in the long run.

You can find genuine replacement parts displayed at your Briggs & Stratton service dealer. They are the same precisely engineered, rigidly inspected



and quality controlled parts that made your Briggs & Stratton engine so great to start with. The parts are packaged with full installation instructions.

Ask for the free booklet, "Operating and Maintaining Your Briggs & Stratton Engine." It will give you valuable information on engine operation, maintenance and installation of replacement parts. For the advanced home repairman, there is a more detailed manual.

Keep your Briggs & Stratton service man in mind for major service work. He is one of 25,000 Briggs & Stratton Authorized Service Centers staffed by factory trained

people and stocked with original factory parts. You can locate him in the Yellow Pages under the Briggs & Stratton trademark in "Engines — Gasoline."



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Milwaukee, Wisconsin 53201

The quality assurance trademark
people look for

CHEESE SLICER (Continued from page 72)



This wire-cutter cheese slicer provides a practical way to cut cheese. You can make uniform slices to whatever thickness you want, and the slicer is simple to keep clean.

This cheese slicer is a handsome, useful tool that's inexpensive to make. You can purchase a sink cut-out at a cabinet shop for under a dollar to use as the base.

Begin by cutting the 5x7-in. base (A). Use a 1/4-in. dado blade to cut a groove in the base bottom to accommodate the longer leg of the swinging arm (F). Use F as a gauge to check width of the dado. Fit should be snug. Cut a hardwood plug (G) slightly longer than needed. Insert the rod (F) into the groove to act as a spacer. Apply epoxy resin to the sides of the strip and force it into the groove until it contacts the rod. When the epoxy has set, remove rod and sand strip flush.

Cut edge strips (B, C) slightly longer than needed and cement them to the base, after locating and boring the needed holes in strip (C). Tack in place with brads, countersink them and apply wood filler. Trim and sand strips flush.

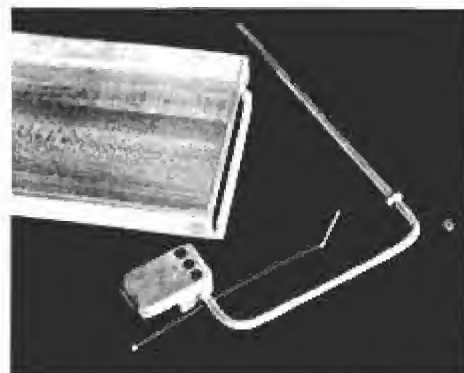
An endpiece (E) supports the over-

hang of the cheese. Cut and attach with epoxy and brads.

Cut the backstop (D) and attach with epoxy and brads. Then cut and shape the hardwood handle (P). Bore only the hole for the rod arm.

Sand all wood pieces smooth with 100-grit paper, then 150-grit. Dust off, wipe with a tack cloth and apply tung oil. When dry, apply carnauba wax, rubbing with 8/0 steel wool between coats. To form the right-angle bends in the swinging arm, see the photo (top right). Bore holes in the arm for the cutting wire (K), a steel guitar string. Insert the wire through the top hole and pull the eyelet (L) tightly against the rod. Bend the wire back on itself about 1/4-in. from the bottom hole for J. Push J through the hole and run the nut up until the wire is taut.

Ream or file the hole in spacing washer (I) for a tight fit over the rod.



Attach machine screw (J) to the cutting wire before positioning the swing arm. The spacing washer (I) is soldered to the arm.

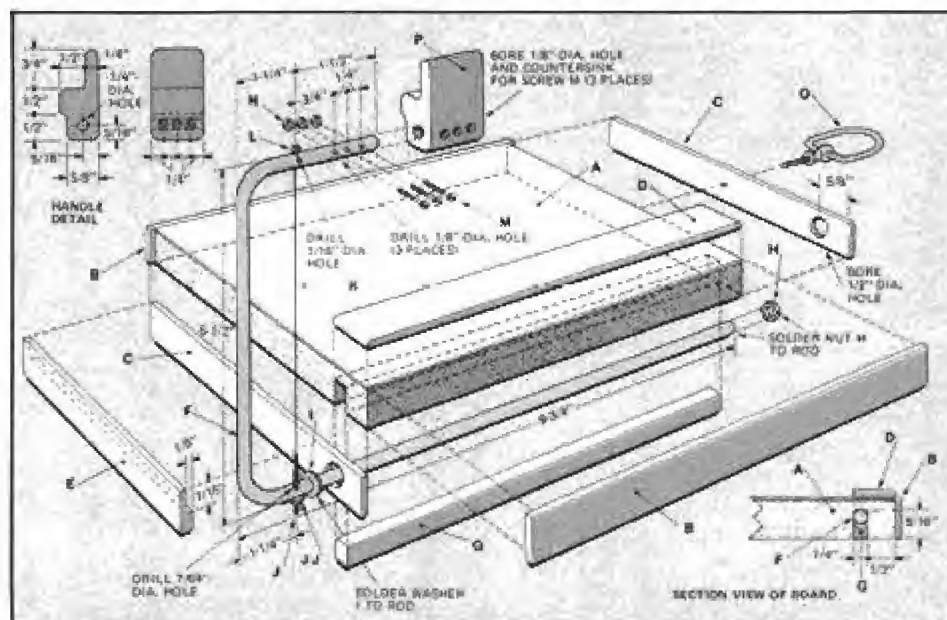
Slide the rod into the base, center the wire in the groove and fit the washer against the base. Remove rod and soft-solder the washer. Bore the threads out of brass nut (H), slip it over the end of the rod and soft-solder it in place.

Attach the wood handle with epoxy resin. After the glue has set, bore and countersink holes for screws (M). Turn in the screw and tighten nuts; then cut off screw ends and file smooth. Finally, attach the decorative ring.—*Frank H. Day*

MATERIALS LIST—CHEESE SLICER

Key	No.	Size and description (use)
A	1	5x7" particleboard topped with plastic laminate from sink cutout (base)
B	2	1/2x1 1/2x7 1/4" hardwood (edge strips)
C	2	1/2x1 1/2x5 1/4" hardwood (edge strips)
D	1	1/2x1 1/2x7" hardwood (back stop)
E	1	1/2x1 1/2x4 1/4" hardwood (end support)
F	1	1/4"-dia. x 18" long steel rod (swinging arm)
G	1	1/2x3/4x7 1/4" hardwood strip
H	1	1/4"x20 brass nut—drill out threads to force fit nut on 1/4" rod
I	1	3/16" washer; ream hole to force fit 1/4" rod. Locate and soft-solder in place
J	1	4-40 machine screw with head cut off; one end flattened and bored to accept wire
JJ	1	nut for J
K	1	stainless-steel guitar 3rd (G) string, .022" dia.
L	1	brass eyelet, included with guitar string
M	3	6-32 machine screw
N	1	nut for M
O	1	decorative screw-on ring
P	1	3/4x1x13/4" hardwood (handle)

Misc.: epoxy resin, sandpaper, 1 1/2" brads, steel wool, tung oil, carnauba wax.



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*EPA estimates for comparison, standard 5-speed manual. Four by fours: **21** est. mpg, **29** est. hwy. Actual mileage may differ depending on speed, trip length and weather. Actual highway mpg will probably be less. California mileage lower.

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†Skyroof available Feb., '81.



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From Volkswagen,
the Aerodynamic Research
racer is turbodiesel powered.

Volkswagen left the rear-view mirrors off this model: It's not meant for driving on the street. And since this racer runs only against the clock, the mirrors aren't needed on the track either. This isn't a new Formula Vee, or a car for any other series where wheel-to-wheel competition thrills motorsports fans. The Aerodynamic Research Volkswagen (ARV) is a race car of a different sort: It's racing to push back the limits—limitations in mpg imposed by engine efficiency and density of air.

So streamlined is the ARVW and so efficient is its turbodiesel Six that it achieved 39 mpg at 155 mph and, at its record speed of 224.99 mph, it averaged 17 mpg. The drag coefficient of the 1950-pound ARVW is an astoundingly low 0.15. By comparison, cars like the Mazda RX-7 and Porsche 924 Turbo are blunt-nosed, aerodynamic louts with their 0.34 drag coefficients.

The Six is the 2.4-liter diesel used in Volkswagen's commercial LT trucks in Europe, and the one Volvo buys to use in its passenger cars sold here. In stock form it puts out between 74 and 78 hp; in the ARVW, it cranks up 173 hp at 4800 rpm. That's the kind of performance you get—while preserving fuel economy—by turbocharging a diesel.

Turbocharger on '81 Saab Turbo models is controlled by pressure in the intake manifold. Distributor is mounted on camshaft cover.

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Turbocharger City

It's just a matter of time before all diesel engines are turbocharged, according to the true believers at Garrett AiResearch. The exhaust-driven units are especially suited to small, passenger-car diesels, said the engineers I visited at the world's largest manufacturer of turbochargers in Torrance, Calif. Observing the technicians and assembly people at Garrett may be the closest I get to seeing Swiss watchmakers in action. Finely machined, miniature-size turbos spinning at 100,000 rpm make even the most exquisite ticking timepieces seem dull.

Garrett makes these high-speed spinners for almost all turbo car makers. We drove to Garrett's headquarters in Saab's gas-engine Turbo Sedan (see I&M, page 30, June '80). Garrett's turbocharger, coupled with Saab's 1981, Type-H, fuel-injected Four, provides the power that makes this new sedan (even with automatic transmission) one of the hottest setups around. A slightly smaller turbine for '81 acts to build boost faster, and results in better response at low speeds. I appreciate how strong is the turbo kick in the pants, all too well, since my family car is a mild, naturally-aspirated '79 Saab EMS (9000 miles on the

odometer, 26.56 mpg overall, no trouble). Well, maybe next time around, I'll order the Turbo to soothe that itch under my right foot.

No LeTurbo, yet

Renault has a turbo LeCar in Europe that has created quite a stir, but it has yet to be imported. Maybe after the new, five-door LeCars are on sale a while, AMC will think turbo. The five-door joins the three-



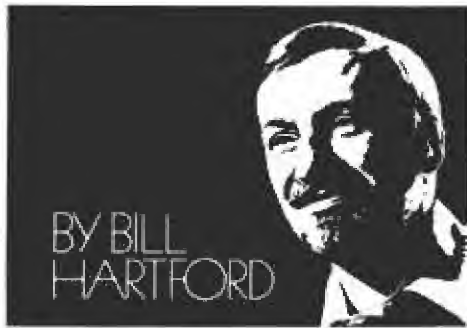
Five-door Renault LeCar is now on sale.

door LeCar and R18i in AMC/ Renault showrooms this month.

Car quiz

It's fun to see if you can identify a car from just a glimpse of it—a tail-light, portion of grille, a wrinkle in its sheet-metal or maybe a wheel. This wheel is standard equipment on a certain car in its home country. The wheel is familiar there, but it hasn't been seen here yet. It's a most appropriate shape for a wheel on this car, since it is identical to a component used in the construction of the car. It's a wonder that no one thought of making these wheels for the car when it was first introduced in 1978. Is this quiz too easy? If it's not easy enough for you, see the answer to the identity of our mystery car in next month's I&M.

Neat wheels! The shape identifies car quickly.



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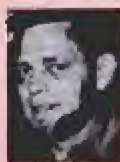
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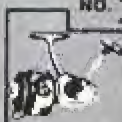
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7187	CHILTON AUTO REPAIR 64-71 for all American cars	\$18.95
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9561	CHILTON TRUCK REPAIR MAN 61-71 for all 4-24 ton models	\$19.95
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8693	TRIUMPH TR7 75-79	\$10.95
8192	VALMART 68-76 all models inc Scamp, Signette	\$9.95
0567	VEGA 72-73 all 140 DO & 61 140 DO models	\$9.95
0884	VEGA 74-77 all models inc Monza, except Cosworth/Vega	\$9.95



A lightweight, three-pound string trimmer from Bolens attaches to all of that firm's electric-start riding mowers and garden tractors. The trimmer, which rides along on its own carrying bracket on the machine, is simply hooked up to either the solenoid or battery, depending on the vehicle model. The 12-volt trimmer cuts a 9-in. swath and has a 20-ft. straight cord and a 10-ft. coiled cord. You tap the trimmer on the ground to activate the automatic line feed when needed. The Bolens trimmer is \$67 from FMC Corp., Outdoor Power Equipment Div., 215 South Park St., Port Washington, Wis. 53074.

The Chew Chew lawn vacuum not only picks up leaves and clippings, but mulches and bags them in one operation. The machine reduces lawn debris to one-eighth its original volume, the maker claims. The self-propelled, 5-hp unit has a 10-bushel bagging capacity. Attachments include a shredder-hopper for shredding branches, a 10-ft. flexible hose for vacuuming hard-to-reach spots and a blower to herd debris into piles for easy pickup. Price is \$892 from Lambert Corp., 519 Hunter Ave., Dayton, Ohio 45404.



This lightweight, front-tine tiller is designed for suburban farmers with small tilling, mulching, weeding and composting jobs. It has a four-stroke, 2-hp Honda engine and a transportation wheel to insure good mobility. For easy in-use handling, the 20.5-in.-wide tines stop turning once the clutch lever is released. The tiller is \$279 from American Honda Motor Co. Inc., Power Products Div., 100 West Alondra Blvd., Gardena, Calif. 90247.



This compact tractor has an 11-hp Briggs electric-start engine and a five-speed transmission. The rear bagger has five-bushel capacity and fits Wheel Horse B-series tractors with tunnel-design mowers. Two removable containers collect clippings. A transparent tube allows a visual check of clipping flow. The tractor is about \$1355, the 37-in. side mower attachment is \$390 and the rear bagger is \$200 from Wheel Horse, 515 West Ireland Rd., South Bend, Ind. 46614.

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Now **\$199⁹⁵**
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Price includes utility shelf, warming rack, grill head, portable base, lava briquettes, hose, fittings and 20-lb. L.P. tank (fuel not included).

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NEW NOW for home and shop

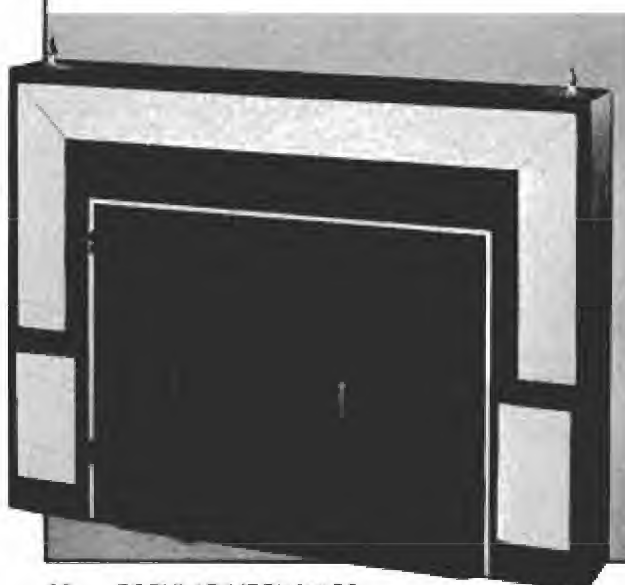
A Tambour-style kitchen cabinets by Excel are designed with a European look. Oak-veneer doors and drawer fronts feature vertical grooves routed full length, accented with brass library pulls. The cabinets are finished with Excelite plastic laminate on all exterior surfaces. The cabinets offer doweled construction for extra rigidity. A number of optional units, such as range hoods and rotating-shelf carousels, give a custom look to the kitchen. For information on sizes, prices and dealer locations, write to the manufacturer: Excel Wood Products Co., One Excel Plaza, Lakewood, N.J. 08701.

B A one-pipe steam-heat system can be made more efficient with an air-vent valve, according to the valve's manufacturer. The Vent-Rite valve bleeds unwanted air. This prevents efficiency-reducing blockage. It disassembles easily for cleaning to prolong its service life. It has an operating pressure of 3 pounds per square inch, and it incorporates a 1/8-in. threaded male pipe connection. You can install this valve by screwing it into the radiator. It's priced at \$9 from Barnes & Jones Inc., 34 Crafts St., Newtonville, Mass. 02160.

C The Coal Cub stove is designed to take advantage of the highly combustible characteristics of coal, according to its maker. The compact heating unit is said to be both efficient and clean-burning. The stove is made of steel plate and it features a baffled airflow for better control of heat. It has a removable ash drawer and alligator shaker grates. A firebrick lining is designed to increase the efficiency of the stove by extending the radiant heat output and prolonging the life of the stove. The Coal Cub is priced at \$340. For more information, contact: Grizzly Stoves, Box 9, Blissfield, Mich. 49228.



D This new fireplace insert burns both coal and wood. Model No. FT8-80, from Suburban, features a thermostatically controlled blower that's built into the front. This makes the unit easy to reach and maintain. Do-it-yourself installation is possible in most fireplaces. The insert plugs into a 110-volt outlet. It is constructed of 1/4-in. plate steel and cast iron, and it features hinged doors with heat-resistant glass windows that permit you to view the fire. This fireplace accessory costs \$900. For more information, write Suburban Manufacturing Co., Box 399, Dayton, Tenn. 37321.



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Ken Heskestad, tankerman, New City, New York



It was mid-June when Ken Heskestad left the Seaweed Yacht Club in Stony Point, New York, to begin his odyssey in a little 12-foot Avon inflatable boat, powered by a Mariner 25 hp outboard.

Twenty-seven hundred bone-jarring miles, 23 locks, 2 punctures and 3 months later, Ken motored "Inflation 1" back up the Hudson River toward home.

Total maintenance for the trip: 3 spark plugs and a new prop to replace one that was destroyed when he ran aground in a fog. Ken says, "Someday, I'd like to retrace the old Viking route back to Bergen, Norway. Whatever it is, the outboard will be a Mariner."

Mariner outboards earned a reputation for outstanding performance on 4 continents before they ever came to North America. And as more of them are getting around, so are stories



like this one. These remarkable outboards from 2 to 200 hp are proving they really are better in the long run.

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Build an extension flash bracket

Here's a versatile flash arm that holds your strobe high above the lens—no matter how you turn the camera.

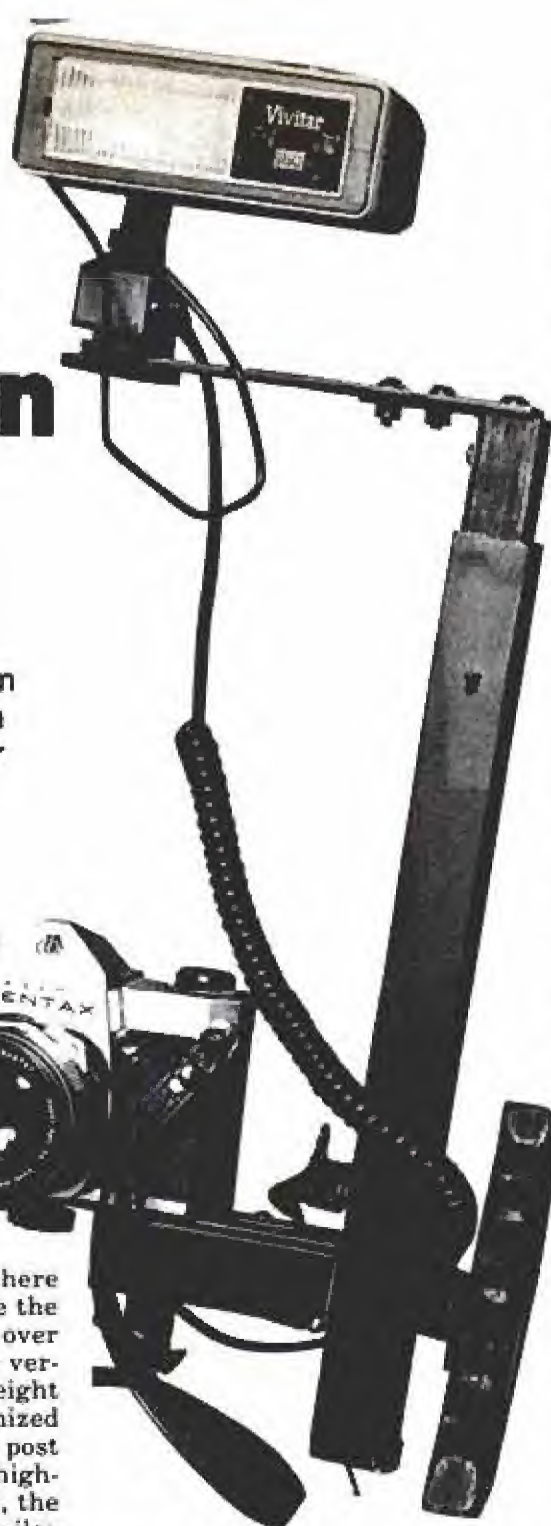
by Frank LaManna

The flash bracket shown here holds the strobe high above the camera and swings to keep it over the lens whether the camera is vertical or horizontal. The lightweight bracket design is easily customized to suit your needs. The center post adjusts to raise the light even higher. Since the post is removable, the flash can be switched to a similar bracket on another camera without removing the whole mount.

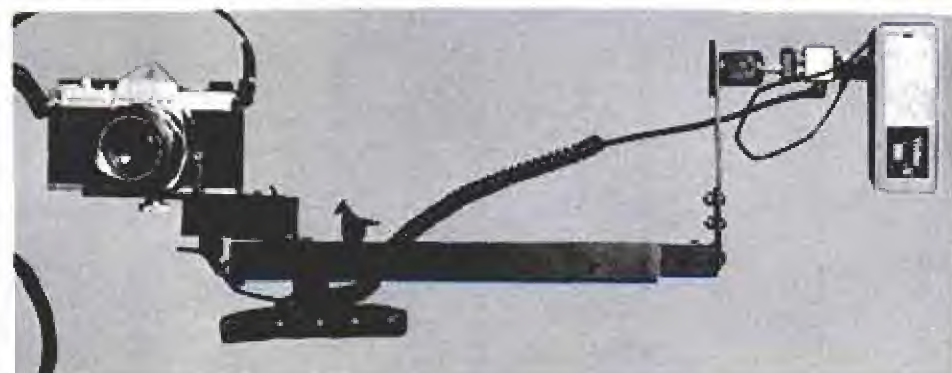
A bracket like this one will help you avoid a red-eye effect in slides and prints where the pupils of the eye seem to be red dots. The bracket prevents the bounce-back reflections causing the problem.

Our bracket also prevents harsh shadows caused by turning the camera vertically and having your strobe off to the side. It always keeps the strobe positioned right above the lens.

Begin by measuring how high above the camera you wish the flash to be. Allow about 8 inches above the lens plus enough more to let the lower end of the flash arm extend 2½ inches below the base of the camera. Mark this length on the square alu-



Dual-purpose strobe bracket helps to eliminate the "red-eye" effect you often get in flash photography and also provides more pleasing, shadowless lighting. Unlike many others, its hinged arm flips to the best position no matter which way you hold the camera. It can be made for less than \$10.



minum tubing. Use a hacksaw to cut the tubing.

Measure 1½ inches from one end of the tubing and position the hinge pin there. Mark locations of the screw holes and remove the hinge.

Cut a 4-inch length of the ¾-inch wood stock and insert it into the aluminum tubing. Using a ⅜-inch bit, drill the holes marked on the aluminum so the bit slightly penetrates the wood. Trim the ends of the hinge leaves to allow clearance for the elbow catches. Attach the hinge to the aluminum, making sure the screws are seated in the wood. The screws will form threads in the soft aluminum, and thread into the wood for added strength.

Cut a second piece of aluminum tubing approximately 3 inches long. Cut a ¼ × ⅜-inch notch into one end to provide clearance for the hinge pin. Fit the hinge pin in this notch and mark locations of the remaining screw holes. Cut a 2¼-inch length of the wood stock and insert it into the tubing. Drill holes and attach the hinge, driving screws all the way into the wood.

Cut a 6-inch piece of ¼ × 1-inch flat steel-bar stock and place it on top of the 3-inch length of tubing as shown. Drill a ⅜-inch hole about ¼ to ⅓ inch from the end nearest the flash arm. This hole should go through the steel and aluminum into the wood. Enlarge the hole in the steel using a ⅜-inch bit. Attach the steel to the aluminum tubing.

Test-position the striker and elbow catch so they will hold the flash arm properly in the up position. Mark the hole in the striker plate on the steel bar. Drill a hole through to the wood with a ⅜-inch bit, then enlarge the hole in the steel to ⅜ inch. Use a screw to hold the striker plate in place. Place the catch, drill the necessary ⅜-inch holes and attach with the screws provided. Adjust with washers if needed. File all edges smooth. Carefully drill a ½-inch hole in the steel bar about 2 inches in from the opposite end. This is for attaching the flash bracket to your camera using a ¼-20 thumb-

(Please turn to page 189)

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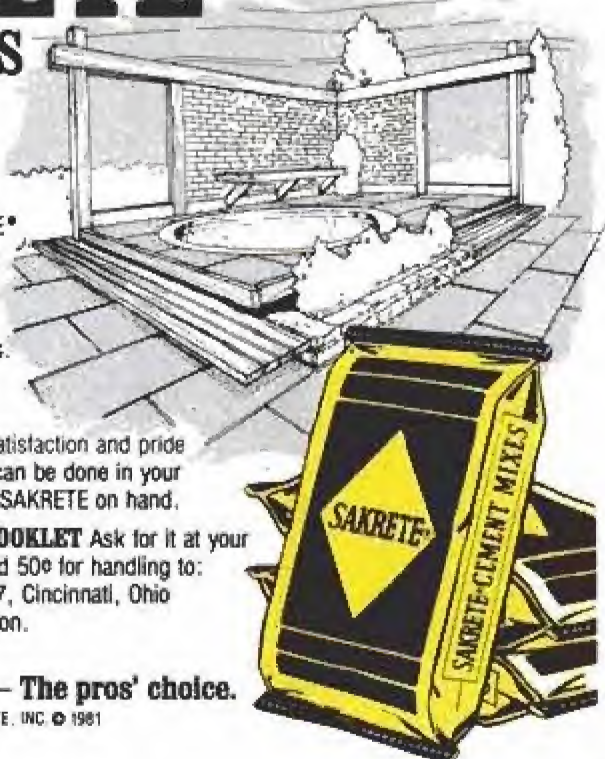
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The Easy Gillespie Way!

With the Gillespie Brass Refinishing System, you can renew solid brass, copper & bronze to it's original beauty... and protect it.

Just picture an old treasured brass collectable that has years of corrosion, tarnish or even paint on it being transformed back to it's original gleaming beauty.

Here's how it works... apply the Brass Refurbisher, a powerful cleaner (not a polish) that dissolves tarnish, grime and even any old coating or paint. Buff to shine with polishing wool and spray the clear Brass Protector to preserve the shine for years. It's easy... it's fast!

AVAILABLE IN THE DO-IT-YOURSELF DEPARTMENTS OF HARDWARE, PAINT & HOME CENTERS



FREE "RESTORE BRASS" BOOKLET ON REQUEST: WRUSE GILLESPIE, DEPT. PM 301A, 1829 MEMPHIS, TN 38111

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The Guard is America at its best.



You can't train somebody to be a hero. And the Army Guard people on this page would be the last to label themselves that.

But it was Army Guard people like these who flew into the teeth of a devastating blizzard last winter to save a farm family trapped by a big, unexpected snow. And it's Army Guard people like these, working in their own communities, who help their neighbors and friends in all kinds of emergencies. Because from blizzards to floods to tornadoes, Army Guard people perform at their flat-out best.

And you could, too. You've already got the training. You know the ropes. You're ready. And in the Army Guard, you'll keep your vital skills sharp. Emergency-ready. Combat-ready. You'll train in your own community with friends and neighbors. You'll hold on to important benefits, too. Along with your pay and stripes.

But it won't just happen. You've got to do something first. Get in touch with the Army National Guard representative on your post. Or call us toll-free 800-638-7600*. It won't cost you a penny to find out what the Army

Guard offers. But, we can promise you one thing. A chance to be one of the best.

*In Hawaii: 737-5255. Puerto Rico: 723-4550. Virgin Islands (St. Croix): 773-6438. Maryland: 728-3368. In Alaska, consult local phone directory.



The Guard belongs.

Actual color-enhanced electron microscopy photograph of carbon magnified 3,000X.

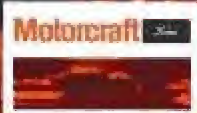
**THIS IS THE ENEMY
OF YOUR SPARK PLUG.**



MOTORCRAFT BURNS IT AWAY.

Take a good look at the enemy. Sooty carbon on the tip of your spark plug. It blocks power. Robs gas mileage.

Motorcraft Extended Tip Spark Plugs burn carbon away. Actually clean themselves as you drive.



Motorcraft Spark Plugs from Ford.
For the future of your car.
For sure.

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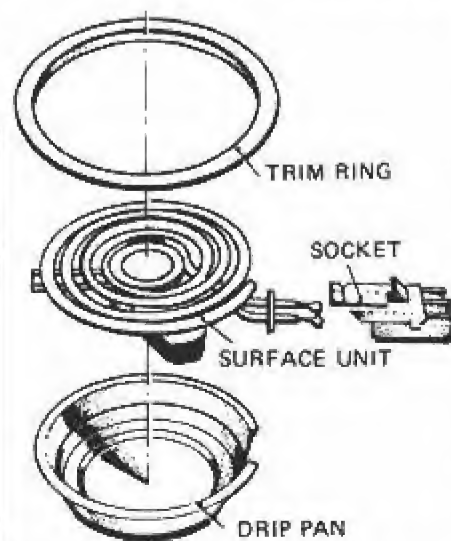
APPLIANCE CLINK

QUESTIONS ANSWERED

Burning burner

I own a Kelvinator range model No. RF343D that is 13 years old. The 8-in.-dia. burner has given me a problem for a long time. First, the wires burned off the connector in the socket. I kept reattaching them until they became too short. Then I replaced the connector. Each time the connector has been replaced, I smell burning Bakelite as soon as I turn on the burner. What could be the problem?—Wally Eggebraaten, Babbitt, Minn.

Sounds like the terminals on the surface burner unit have become distorted. This could be due to bad contact between the burner socket and the burner itself. I would recommend replacing the burner as well



Surface unit and socket on a Kelvinator electric range can be replaced if needed.

as the socket. The part numbers are burner No. 1300708 and socket No. 130914. You can order them from Kelvinator Appliance Co., 4248 Kalamazoo St. S.E., Grand Rapids, Mich. 49508.

Singing refrigerator

I have a General Electric side-by-side refrigerator-freezer, model No. TFF-15SMB. When the fan motor runs, it sometimes makes a noise like a singing teakettle. The noise stops as soon as the door is opened, although the fan continues to run. It doesn't make this noise every time the motor runs. What can be done to repair the appliance?—Mrs. A.N. Harrison, Deer Lodge, Mont.

The noise is probably coming from a worn bearing in the evaporator fan motor, which is located in the

freezer compartment. The replacement fan motor is part No. WR60X5046; the cost is about \$32.

To replace the motor, first unplug the unit. Next, remove everything from the freezer. Remove the screws that hold the back panel (evaporator coil cover) in place. Remove the cover by sliding it down and out of the compartment.

You will see the fan motor about halfway up the back, just above the evaporator coils. Remove the mounting screws and the two wires connected to the motor. The motor bracket and blade assembly must be removed as one unit. When you install the new motor, make sure that you don't bend the fan blades and that the fan is turning in the correct direction.

Dead LED

I have the Sears Kenmore solid-state portable dishwasher model No. 58779-8710. It has LED readout display with Power Miser. When I start the machine, all of the lights turn off and on and the cancel drain light comes on. Can you suggest a solution?—Mrs. A. Reed, Wayne, N.J.

We contacted our source at Sears, who feels that your problem may be in the solid-state control board. There has been a problem with moisture getting into the board and causing an erratic light display. He suggests that you contact your nearest Sears service center and have the unit fixed by a technician.

Getting static

I'm an apartment dweller who gets a tremendous amount of interference on my bedroom FM radio. The problem sounds like clicks and pops. Apparently it stems from the bathroom and bedroom appliances of neighbors. Can I block it somehow?

One aspect that I find curious is that the interference is much worse when the radio is connected to a commercial cable-FM line than when it is tuned to local stations using the a.c. cord as an antenna.—B.P. Solomon, West Lafayette, Ind.

You might solve your interference problem by installing an a.c. power-line filter on the outlet where you plug in your radio. Then plug the radio into this device. You can get this type of filter at Radio Shack (part No. 15-1106) for about \$5.

If there isn't a Radio Shack near you, write to Radio Shack, Consum-

ers Service, 1801 South Beach St., Fort Worth, Tex. 76105. The price at the time of this writing was \$6.99, which includes shipping; verify price before ordering.

As for the interference getting worse when you hook up to a commercial FM line, you are probably picking up some a.c. interference through the amplifier in the master antenna system in the building. We suggest contacting the commercial cable company and asking them to check the building's system.

Replacing a gasket

I have a Sears Coldspot refrigerator model No. 106-668110. The magnetic gasket on the door no longer seals properly. My question is: Can I install a new gasket myself or does this call for a repairman?—C. Hotaling, Brooklyn, N.Y.

The part for the door gasket is No. 654024; it costs \$17. You should be able to install it yourself. To make the new gasket flexible and easier to install, soak it in approximately 4 in. of very hot water (140°-160° F.) for about 10 minutes.

While the gasket is soaking, remove everything from the door shelves. Lift the inner edge of the old door gasket. You will see a metal strip, attached with Phillips screws, which holds the gasket to the door.

Starting at the middle of the door, loosen all of the screws. Work up one side, across the top and halfway down the other side. Don't loosen the bottom screws and don't remove the screws. Next, peel the old gasket out from under the metal strip on the top part of the door and along both sides. Let the gasket fall.

Remove the new gasket from the hot water and dry it with a soft cloth. Position the gasket on the door. Make sure the hollow or balloon section of the gasket is on the hinge side of the door. Attach the new gasket over the top of the metal strip. Tighten screws on top and along both sides. Loosen the screws that hold the bottom half of the old gasket. Finish removing the old gasket and complete the installation of the new one. **FM**

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

Almost Like Growing "INSTANT SHADE"...
Once Established, Amazing
Super-Soaring Hybrid

ZOOMS ROOF HIGH IN JUST ONE SINGLE YEAR!

—and keeps on skyrocketing 30—40—50—EVEN UP
TO 60 FEET HIGH, OR MORE, in less time than most
trees nudge themselves a few feet off the ground.

Actually Soars Up To A Tower Of ROOF-HIGH Beauty IN JUST ONE YEAR!

Yes! Based on amazing average weekly and yearly growth rates reported by plant scientists —It grows **SO FAST**... arches out **SO WIDE**... you can actually take a ruler and measure the incredible difference in height every 2 to 3 days! OR, to really leave your neighbors gasping in awe and wonder, give them a yardstick and let them measure the difference IN FEET, every 2 to 3 weeks!

GROWS MORE IN JUST ONE MONTH THAN MOST TREES GROW IN AN ENTIRE YEAR!

Because according to plant experts, Gov't scientists and Botanical Gardens who researched this wonder-hybrid... once established, you merely water it once-a-week, and be absolutely floored as it **GROWS** up to an average of A FULL 1/2 FOOT WEEKLY! during its **SUPER-SOARING** growing season!

That's right! Grows higher than even a full grown Flowering Dogwood IN JUST ONE SINGLE SEASON! Grows higher than even a full-grown Star Magnolia IN JUST ONE SINGLE YEAR! Yes, thrusts itself so high, so fast that it actually towers over even a Japanese Red Maple, Cherry Tree or even the most graceful silky Willow, in such a ridiculously short time you will simply refuse to believe your eyes!

PLANT NOW—REACH OUT AND TOUCH ITS LUSH, THICK BRANCHES FROM YOUR SECOND STORY BEDROOM WINDOW BY NEXT SUMMER!

Think of it—just 12 months or less! No doubt about it, There's just not another "Instant" Shade Tree like it on this planet! Because—this year, thanks to this miracle of plant science, instead of spending a small fortune on a tree and then waiting half a lifetime for it to grow... get set for the garden-wonder of your life as this super-soaring hybrid rockets forth from a tiny sapling to a tower of roof-high beauty IN JUST ONE SINGLE YEAR!

GROWS IN VIRTUALLY ANY SOIL —REQUIRES NO SPECIAL CARE— —SOARS INTO A MASTERPIECE OF BEAUTY IN JUST A MATTER OF MONTHS!

Best of all, unlike most trees that demand constant care, constant pampering... about the only thing you do when you plant this super-growing wonder-hybrid is water it and enjoy it! That's why leading botanical gardens... landscape artists... garden editors... can't stop raving about its indescribable beauty... its trouble-free care... its surging, towering growth.

Small wonder that leading experts hail it in the most glowing terms... recommended it again and again for homeowners who want a stunning display of beauty, both a wind and privacy screen, and deep, cool shade... and with practically no more work than a thorough watering each week!

VITAL STATISTICS FROM LEADING EXPERTS MATURE GROWTH SIZE:

as much as 50 to 70 feet.
MATURE GROWTH SPREAD: as much as 30 to 35 feet.

ZONE OF HARDINESS: Hardy from deepest South to as far North as Vermont, Minn., Quebec, British Columbia, Winter hardy in areas where temp. drops as low as 50 degrees below zero!

LIGHT NEEDS: Grows best in sunny location.

DECORATIVE MERITS: Highly recommended by landscape architects as beautiful, decorative specimens for homes, parks, highways etc., where exceptional fast growth and beauty are required. Perfect for fast screening and privacy.

RAPID RATE OF GROWTH: Experts report growth rates of up to 9 FEET THE VERY FIRST YEAR ALONE on specimen trees. That's more than most shade trees grow in 3... 4... 5... even 7 years. Once established, will grow ranch-house-roof high IN JUST ONE SINGLE YEAR.

CARE: No special care required, just normal garden care. Water Fully once weekly. No spraying, no dusting, no special feeding. Naturally resistant to most diseases, pest or insects.

WE HAVE AT THIS MOMENT ONLY A LIMITED SUPPLY AVAILABLE FOR RELEASE TO THE PUBLIC—FULL SUPPLY WON'T BE READY UNTIL 1982. SO ACT NOW!

Now the price of this super growing shade tree is not \$20 or \$30 you might expect, but a mere \$3.95.

That's right, only \$3.95 for this magnificent Beauty that rewards you with such a glorious display of growth IN JUST ONE SINGLE YEAR. However our supply is limited! Full supplies from the growing fields will not be ready mid to late 1981 or early 1982. Therefore, all orders must be shipped on a first-come, first shipped basis. To make sure you don't miss out... **ACT NOW!**

SATISFACTION GUARANTEED— OR MONEY BACK!

Remember: Satisfaction is fully guaranteed. You must be thrilled in every way with this spectacular 1-a-s-1 growing shade tree or **RETURN AT ANYTIME** within 90 days for a full refund of purchase price... **ANYTIME** within 1 year for free replacement. Could anything be fairer? Now is the time to order and plant—so send the no-risk coupon today!

FROM MAN HIGH First year



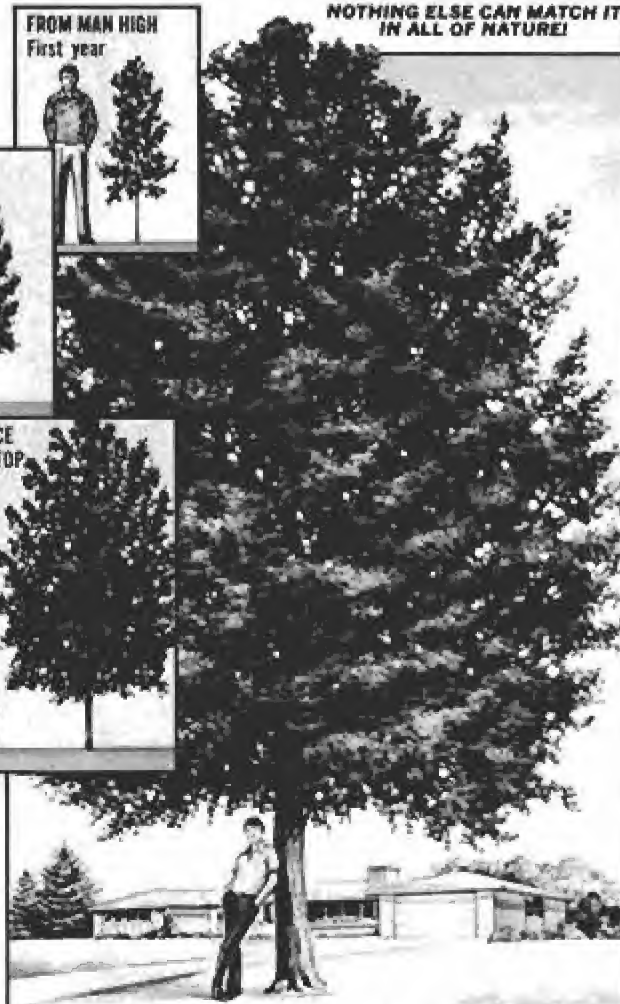
TO RANCH-HOUSE ROOF HIGH by next year



TO TWICE HOUSE TOP TALL in just a few short years!



NOTHING ELSE CAN MATCH IT
IN ALL OF NATURE!



Grows More in One Month Than Most Other Shade Trees Grow in AN ENTIRE YEAR—More in One Season Than Ordinary Shade Trees Grow in 2 Years, 3 Years or Even 5 Years! (Illustration shows magnificent size, spread and beauty of mature Populus Canadensis Eugenei.)

MAIL NO-RISK COUPON TODAY

WILLOW RIVER NURSERY SALES, INC., Dept. RHT-32
346 Maple Ave., Westbury, N.Y. 11590

Yes, please rush me the SUPER GROWING SHADE TREE(S) indicated below:

- ☐ (#001) 1 for only \$3.95 plus 75¢ post. & hand.
- ☐ (#002) 2 for only \$8.95 (SAVE over \$1.00) plus \$1.00 post. & hand.
- ☐ (#004) 4 for only \$10.00 (SAVE over \$7.00) plus \$1.50 post. & hand.
- ☐ (#010) 10 for only \$20.00 (SAVE over \$20.00) plus \$3.00 post. & hand.
- ☐ (#020) 20 for only \$30.00 (SAVE over \$55.00) plus \$5.00 post. & hand.

If after receiving my order I am not fully delighted, I may return anytime within 90 days and you will refund my purchase price in full (less only post-age and handling costs).

Total amount enclosed \$_____ (N.Y. Residents add sales tax). No COD's please.

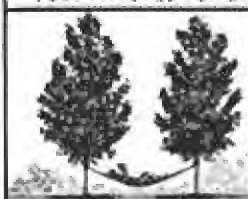
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Address _____

City _____ State _____ Zip _____

Weather conditions will determine date of shipment. Your trees will be shipped in early spring for proper planting time in your area.

JUST MINUTES TO PLANT — SOARS UP TO ROOF-HIGH IN A SINGLE YEAR!



Here's a luxury sight you don't have to wait half a life-time growing — a matched pair of these towering show-pieces.



Picture your patio bathed in the cool, fragrant beauty of this show stopping miracle tree from early spring to the first snows of winter.



Just a few minutes planting time, a few seasons' growing time, rewards you with twin towers of beauty.

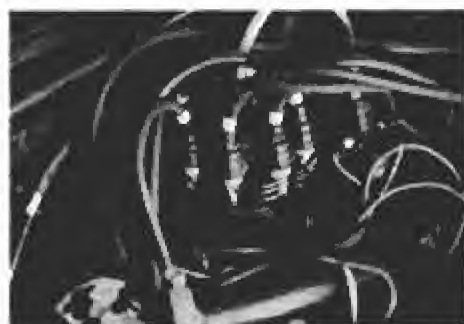
THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Gaze into your distributor

I've always been intrigued by the idea of being able to peer inside my engine. I did the next best thing and bought myself a clear-plastic distributor cap. Whether this cap will ever prove practical, I don't know, but I love to raise the hood at night and watch the blue ring of sparks flick from rotor to cap terminals.

Cal Custom makes a full line of



Clear-plastic distributor cap lets you watch the action while the engine is running.

clear distributor caps for nearly all makes and models of engines with point ignition. The one for my Camaro cost \$10.45. Cal Custom distributes its wares through most chain auto stores.—*M.L.*

Long-distance lubing

Some of the toughest jobs the lube-it-yourselfer has is to get at the two grease nipples atop your car's upper ball joints.

Metrifast, though, makes a \$12.50



Lube kit allows you to grease hard-to-reach ball joints and other grease fittings.

kit that lets you run a high-pressure nylon tube to those hidden grease fittings, so you can lube them from a more convenient location. I installed two kits in my 1974 Merc wagon in about half an hour, using existing holes in the lower A-arms.

The Metrifast kit includes all fittings. Each kit comes with 10 feet of tubing. Order from Metrifast, 51 South Denton Ave., New Hyde Park, N.Y. 11040.—*M.L.*

A boost for sagging springs

If your coil springs or leaf springs are beginning to feel as if they're made of limp noodles, don't rush out to buy new ones. You can stretch the



Adjustable air bags with remote filler tubes help beef up sagging suspensions.

life of your present set with Polyair Springs.

These air bladders are fully adjustable to suit your preferred ride height or to compensate for an overloaded vehicle. When used on fairly new suspensions, Polyair Springs can extend the life of shock absorbers because they absorb some road shock. Price is \$58.70 for the front and \$73.35 for the rear. Contact Air Lift Co., Box 12150, Lansing, Mich. 48901.—*T.A.*

Defouling import-car plugs

Sparkplug lead fouling prevails primarily in imported cars that use leaded gasoline and are driven mainly in town. My 1973 VW hasn't fouled its plugs in 8000 miles. The reason lies in a set of devices called Bauer condensers.

Bauer condensers placed on



Condensers keep sparkplugs from fouling in car engines that still use leaded fuel.

sparkplugs allow current to build up and discharge more quickly and with greater intensity than normal. This helps to keep plugs clean of deposits.

Cost is \$51.80 for the four you'll need for a four-banger engine. They're available from B.G.A.F. Bauer Condenser Distributors, 3250 Highway 22 W., Somerville, N.J. 08876.—*Mort Schultz*

HEI module tester

Since GM went across the board with its High Energy Ignition System, it was only a matter of time before test equipment specifically designed for HEI came on the market. One of the best we've found comes from Kent-Moore Tool Div.



High Energy Ignition tester simulates normal operating conditions as you do tests.

The tester simulates normal operating conditions of the HEI module by means of an electronic circuit. It indicates a pass or fail for each test sequence. The tool is part No. J 2464-E and sells for \$141.15 from Kent-Moore Tool Div., 29784 Little Mack, Roseville, Mich. 48092.—*T.A.*

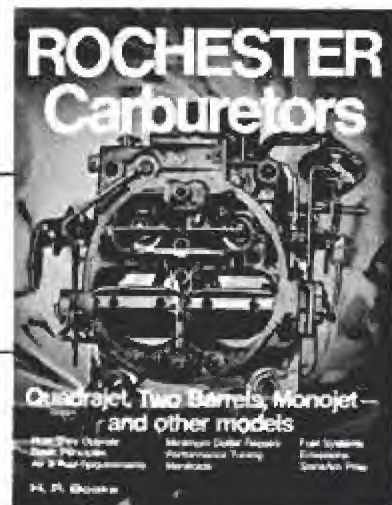
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With just this one low cost power-feed machine in a corner of your garage or basement, you can set up a profitable business by supplying lumberyards, cabinetmakers, carpenters, remodelers, contractors and hobbyists in your area with custom-planed lumber, trim, molding... ALL of their millwork requirements. Supply picture molding to art shops, hardware and department stores, or sell direct to framing shops. All standard patterns in stock... custom knives ground to your design or sample.



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More Than Expected: "This machine pays for itself by making money out of scrap boards. It is a very well built machine and I confess it is more than I expected for its price. It does everything you say it will."

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JAY HEDDEN—Editor of WORKBENCH Magazine

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...the first real
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mowing circles.



A yard with trees is a yard full of circles! Get your hands on a DIXON Zero Turning Radius mower and cut mowing time at every turn.

- Cuts clean without the usual back & forth acrobatics.
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Lombard, Illinois 60148

POCKET STEREOS MAKE IT BIG (Continued from page 66)

Recorders and radios

So far, two pocket stereo cassette recorders have hit the market, too: Aiwa's TP-S30 (\$200) and Sony's TCS-300 (\$220). Surprisingly, they differ considerably.

Aiwa's is the smaller of the two, with a built-in microphone for monophonic recording, and two very ingenious input jacks. Plug a microphone into one of them, and it substitutes for the built-in mono mike. Plug it into the other input, and it feeds into the right channel, while the built-in mike feeds the left for stereo.

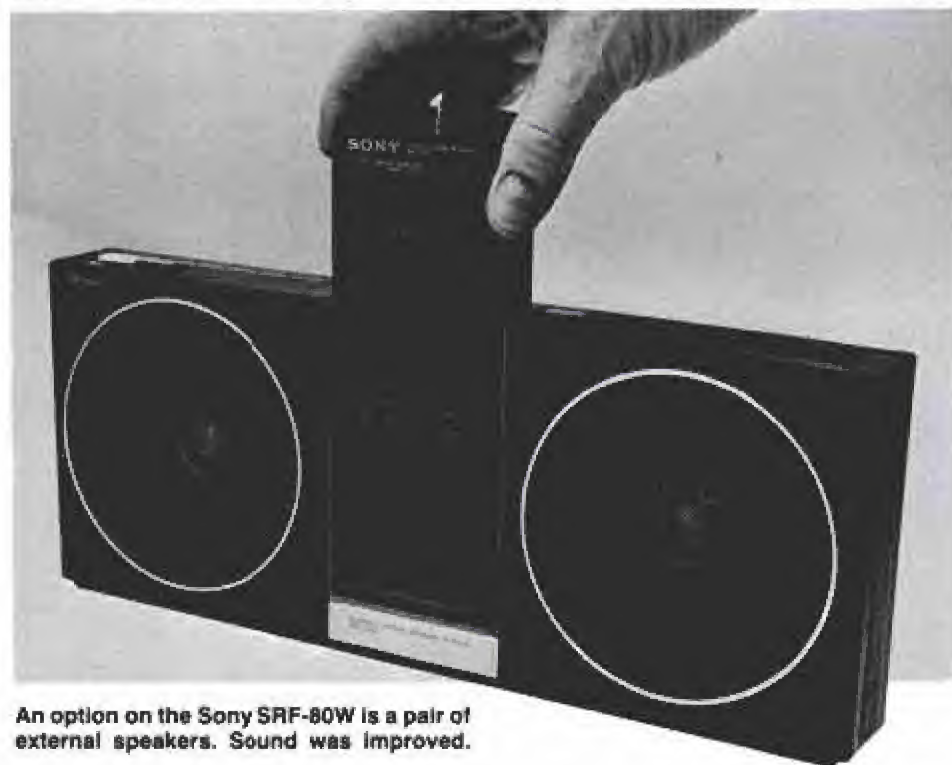
Sony's recorder is a bit bigger and heavier, but has more built into it. It features a stereo mike (instead of a mono one), a speaker for monophonic playback, and separate jacks for stereo and monophonic headphones. It also has an LED pre-end alarm to tell you when tape is running out.

Sony also offers a pocket stereo radio with just as many clever

the radio's sound is fed through the speakers. Power is supplied by four C cells in the speaker cabinet, or from an optional a.c. power supply. An auxiliary input jack and cable are supplied, so you can also play your Walkman through the speakers. The system doubles as a table model or portable (shoulder-strap hooks are provided). Sound through the speakers is decent; the headphone fidelity borders on the sensational. Alaron will have a slightly larger, one-piece, headphone-only radio this spring for just \$55.

Headphones

The small headphones made for these pocket stereos look very much alike (with the exception of Technidyne's, which fold in half for easier carrying). All the headphones share the same new plug, a miniature version of the conventional home stereo phone plug. But they vary in sensitivity and impedance, so some



An option on the Sony SRF-80W is a pair of external speakers. Sound was improved.

design features as its tape machines. The SRF-80W (\$220) is actually a two-part system. The pocket part is a cigaret-pack-sized radio designed to fit into a shirt pocket. Its tuning and volume controls, earphone jack and FM stereo light are all on top, where you can see them without lifting the radio from your pocket. The on/off, FM/AM and mono/stereo switches are on the front; the headphone cord doubles as an FM antenna.

Part two of the Sony is a powered speaker system into which the radio part fits. Unplug the earphones, and

phones will sound distorted when used on players of other makes. If you want a combination, try out various phones first.

You can also use these small headsets with your home stereo system, if you can get an adapter plug (Sony includes one with its headsets, as will Audio-Technica with its new Point One phones). There are also mini-headsets (from Pickering, Mura and Audio-Technica) with large plugs to fit home stereos. Pickering's comes with an adapter for the pocket stereos.

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HINTS FROM READERS

Shovel-handle dibble



Make a hefty planting dibble from a broken shovel handle by shaping its wooden end as shown. It's useful for small bushes and bulbs.—*Walter A. Burton*

Expired card still works



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An outdated credit card is a handy glue spreader when you cut sawtooth edges.—*Jack A. Adams*

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CAR CLINIC

SOLUTIONS
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BY
MORT SCHULTZ



Stopping diesel leaks

There is an oil leak at the rear crankshaft seal of my 5.7-liter GM diesel engine. It is not unique. I have looked under 50 1979 and 1980 GM diesel-equipped cars in parking lots and showrooms, and all the engines I've seen leak oil. My dealer has replaced the seal, but it hasn't made any difference. Is this an inherent problem? How do I get rid of it?—P.K. Venkiteswaran, Brantford, Ont.

Complaints have reached me from many sources about GM diesels leaking oil—and not just from the area of the rear crankshaft seal. Not long ago, GM issued a bulletin listing practices to help control oil leaks. In addition to procedures outlined in service manuals, the following should be brought to your mechanic's attention as he attempts to stem oil loss (remember, this information should be used in conjunction with procedures in the service manual):

■ **Rear crankshaft seal**—Coat the grooves of a new seal with GM sealer 1050026. Install the new seal, making sure to obtain the proper "crush" by setting torque to the specification in the manual. Then coat the bearing cap and seal end with the sealer.

■ **Front and rear oilpan seals**—Examine the front cover for damage. Apply oil to seals before installing seals in the front cover and rear bearing cap. Apply GM sealer 1050026 to each end of the seal where it comes in contact with the cylinder block. Apply oil to the lip of the oil pan where it comes in contact with the seal area. Install flow control valve 8997446 to reduce crankcase pressure. If the crimped area of the flow-control valve leaks after it's installed, coat it with epoxy.

■ **Oilpan side-rail seals**—Examine the oilpan for damage. File off any dimples on surfaces where seals go. See that tabs on the side-rail seals fit into grooves in the front and rear seals, and that adequate sealer is applied to each joint. Install the pan

carefully, so seals aren't dislodged.

■ **Valve covers**—Clean valve covers and cylinder heads. They must be free of oil, grease and old sealer. Reinstall valve covers, using RTV sealer as gaskets.

■ **Injection-pump adapter and seal**—See that the lower adapter-to-block bolt is equipped with a washer. Apply chassis lubricant to the adapter seal to keep the seal straight as it's being installed. Use pump adapter-seal installer (tool No. J-28425) to install the seal.

■ **Intake-manifold seals**—Seals and surfaces must be dry. Use RTV sealer on ends of the seals to hold them in place, but don't apply sealer anywhere else. It may act as a lubricant and cause seals to shift as they're being assembled. If a seal won't hold steady and the gap between the block and intake manifold is less than .050 inch, discard the seal and apply a bead of RTV sealer. It will serve as a seal. However, don't start the engine for four hours to let the RTV sealer cure properly.

■ **Vacuum pump**—Examine the O-ring seal for damage. Replace the seal if it's shot.

■ **Water pump**—Apply GM sealer 1050026 to threads of the two lower water-pump-to-front-cover bolts.

■ **Rear oil-gallery plugs**—Make sure both of them are tight.

Too close for comfort

The automatic transmission of my 1977 Mercury Grand Marquis has developed a slow leak. In order to have it repaired, I must pay to have the transmission removed and disassembled, which is very costly.

I was told by my mechanic that the trouble has been caused by the catalytic converter, which is too close to the transmission. He says that heat from the converter is affecting the seals. He also claims that this is common in Ford Motor Co. cars. If this is true, shouldn't Ford fix my car free of charge?—Jayne Odding, San Francisco.

I don't want to get your hopes up, Jayne, so I'll just say "maybe." Ford has acknowledged the possibility that a catalytic converter may overheat and affect the transmission, especially if the engine has been running on an overly rich fuel mixture. As a Ford spokesman says, "The condition is not beyond belief."

According to my source, the way to handle the problem is to contact the Ford Parts and Service field office at Box 1740, San Jose, Calif. (408-262-9110).

The decision of whether to make an adjustment is left to a field service representative. If you aren't satisfied with the decision, you can request that the Ford Consumers Appeals Board review the case.

In case you aren't familiar with this group, it consists of two dealers and three representatives from consumer groups. After hearing the case, the group votes. If the vote is in your favor, some settlement is made.

There are seven Ford Consumers

(Please turn to page 106)

More brake per mile

"More than any other factor, your driving habits affect the life of your car's brakes," says the Automotive Information Council (AIC) in recommending several ideas to help extend brake life. They work for me. My car still doesn't need brake repair, even after 55,000 miles.

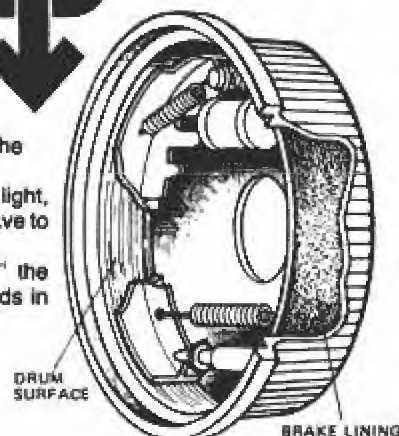
■ Unless a sudden stop is necessary, don't slam on the brakes. Apply them gradually.

■ Try anticipating stops. For example, coast to a traffic light, giving the light a chance to change. Maybe you won't have to apply the brakes.

■ Never rest your foot on the brake pedal. "Riding" the brake causes premature wear by putting linings or pads in contact, however lightly, with drums or rotors.

■ Inspect linings or pads yearly to make sure they aren't worn. If linings or pads wear down to the metal, rivets or parts of shoes will scrape against brake drums or rotors.

PM CAR CARE



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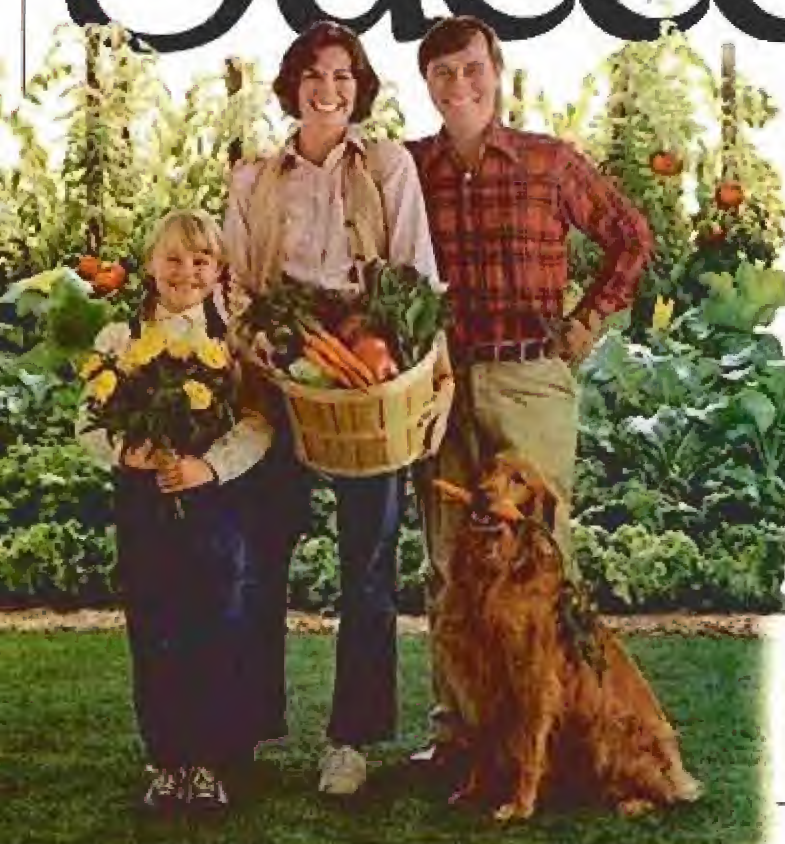
The result? Greater yields. So if you want more flowers, more vegetables and fuller shrubs (and who doesn't), make sure your garden's eating right with Burpee Grow Fertilizers. There's more good news. For the first time ever, both

Succeed.

Burpee Seed and Burpee Grow are available in your town. So get your good home garden going. Simply visit your local store and bring home some Burpee seed and feed. Just add water, pull up the weeds, and watch your Burpee Garden grow. And grow. And grow. We've been guaranteeing it for 100 years.

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GARDENS GROW



CAR CLINIC

(Continued from page 104)

Appeals Boards. Each one handles controversies within its geographical area. There are two groups in California (one north and one south), and one each handling Oregon and Washington; North and South Carolina; Virginia; Maryland and the District of Columbia, and New Jersey.

Free professional advice

The rotor of the GM High Energy Ignition (HEI) system has been subject to a failure we professional engineers call dielectric puncture. Microscopic holes burn themselves through the plastic body, usually below the coil contact spring in the center depression of the rotor.

This causes an electrical arc to the centrifugal weights below the rotor, leading to burn-off of lubricant between the weights and pivots. When this happens, excessive wear occurs that destroys the pivots and produces elongated holes in the weights. At this point, engine failure forces the owner to replace the complete rotor shaft assembly at a cost of about \$50.

A recent article in *Plastics World* announces that GM has issued a new

rotor that supposedly eliminates the trouble. The part is made of a thermoplastic polyester which, according to GM, "provides significant performance improvement in high-energy ignition systems and delivers up to double the service life. The rotor, which is exposed to as much as 35,000 volts, has survived 15 million miles of use-testing without failure."

Car Clinic readers may want to substitute this new rotor for their present rotors to prevent a costly repair. The new rotor is identifiable by its off-white color and Delco part No. D438.—A.R. Spahn, P.E., Beaumont, Tex.

Excellent advice, Mr. Spahn. Thank you.

Rest in peace

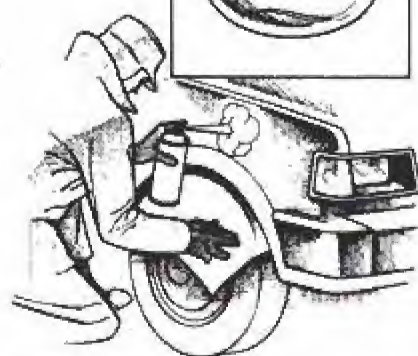
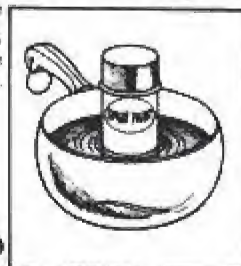
From the day I purchased my great little 1978 Ford Fiesta, it has had one fault, and I won't rest until I find out why. When it is warmed up, the car stumbles and hesitates when I accelerate. Please, please tell me why.—Vern Shell, Reading, Pa.

Sure. It's probably because it can't stand the shot of rich fuel squirting into the cylinders. The condition was recognized early by Ford. If you have had the car looked at by a dealer, I'm surprised the

In hot water

Did you know that, to dry properly, paint should be between 60° and 90° F. as it's applied?

It's paint, not the weather, that has to be warm. So, if you store aerosol cans in an unheated garage or basement, heat a pan of water to about 80° F. Remove the pan from the range and place the paint can in the water. After several minutes, remove, shake and use it. Of course, you could set the can in the house to warm it, but this takes more time than the hot-water method.



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problem is still with you. It is a known condition, which has a quick and easy solution, as follows:

- Remove carburetor from engine.
- Invert the carburetor, so the bottom flange faces up.
- Install a fuel-enrichment valve restrictor in the vacuum channel that lies at the top left corner (about 11 o'clock) of the secondary barrel, as you face the carburetor, so the secondary barrel is below the primary barrel. Use a 1/8-inch drift and hammer to tap the restrictor into place until it is flush with the bottom of the counterbore.
- Reinstall the carburetor.

You can get the fuel-enrichment valve restrictor from a Ford dealer using part No. D8RZ-9L460-A.

A warning, plain and simple

Henry Ortner Jr., technical advisor for the Association of Diesel Specialists, issues this warning to owners of Volkswagen models equipped with 1.5-liter diesel engines:

"Uncontrolled acceleration will happen when the engine draws a quantity of crankcase oil from the valve rocker box through the crankcase ventilation hose to the air cleaner, then into intake manifold and combustion chambers."

He recounts the experience of a driver who lifted her foot from the accelerator pedal to slow down, only to have the engine speed up and the car shoot ahead. She slammed on the brakes and stalled the engine.

I'm reminding you about this again, because it is a serious condition. A recall advising owners to have crankcase-ventilation hose kit 068198999 installed has been issued by VW. You may have received a notice. If you didn't, don't wait for it. Get your car to a VW dealer and have this kit installed.

Mix and match

I know I shouldn't mix radial and bias tires, since control of my car will be affected. But, can I use steel-belted radials and fiberglass- or fabric-belted radials on the same car?—Len Perone, Tifton, Ga.

It's okay, Len. Mixing radials with different belting materials won't affect a car's handling.

GOT A PROBLEM WITH YOUR CAR?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

SERVICE TIPS

■ Oldsmobile reports that an intermittent rattle which seems to come from under the dash on the passenger side of the car may be caused by the transmission dipstick tube vibrating against the airconditioner evaporator case. If so, bend the dipstick-tube bracket away from the evaporator case about 1 inch. The noise seems to prevail in 88 and 98 models.

■ Chrysler warns that if you remove the metal top cover of a 1981 Aries or Reliant instrument panel, don't let the plastic base panel beneath it sit in the sun. Direct sunlight on the panel may cause it to warp. Throw a cover over the panel to shield it from rays.

■ If oil is leaking from the turbocharger of your 1979-80 Mustang, Fairmont, Capri or Zephyr, check the engine oil level before even thinking about replacing turbocharger shaft seals. If the crankcase is overfilled, the turbocharger oil return system is blocked, and oil is being forced past seals. Drain the extra oil until oil level on the dipstick is at FULL.

■ Some 25,000 Chevrolet Impalas and Caprice Classics have been recalled by General Motors for safety-related brake line problems. Because of insufficient clearance of the rubber brake line, the line may wear, and you may lose the brake fluid. Chevy advises owners to return these cars to the dealer for inspection and/or rerouting of the brake line. This affects cars built between August 1979 and March 1980.

PM



Marlboro



17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Dec. 79

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

HOW NASA IS UNWINDING DEADLY SPINS

Early flyers called them "well-diggers," and many pilots died in planes locked in deadly spirals. Now the space agency is finding ways to break the lock.

by Charles Barton

High in the blue sky above the marshes of Virginia's eastern shore, a small, low-wing Grumman American Yankee pitches over in a rolling motion, and begins a corkscrew, nose-down, out-of-control fall toward Earth.

Early pilots called such a spinning descent a "well-digger," and not many of them survived one. But engineering research pilot James M. Patton Jr. has been in

In a classic flat-spin case, test pilot Bob Hoover purposefully pulled up the nose of his F-100A, while reducing power (1). Slats (flaps on the wings' leading edges) automatically deployed at slow speed. As plane approached the stall speed—when wings no longer provide lift—he applied full right rudder and left stick. At slow speed, these "crossed controls" have a dramatic effect. Rudder induces yaw to

the right. As plane turns, left wing is advanced and pushed upward (2) as a result of its positive dihedral (upward tilt). (One theory holds, however, that the primary cause of the rolling is that the right wing tip stalls before the left due to an increase in angle of attack.) Nose dropped (3), and Hoover's plane initially entered a corkscrew spin at 42,000 feet. But almost immediately, the nose came up and the spin went "flat," the plane falling like a whirling maple leaf.

PM art. Ed Valigursky

Nose-to-nose with an F-100



PM art: Ed Votigursky



Hoover deployed drag chute, but it flopped around uselessly on its short lines. At 15,000 feet, he jettisoned canopy, hoping to upset spin stability. But straight-down drop continued. He gave up trying to save plane, then fought high centrifugal forces to eject.



Finally free, Hoover fell faster than plane before chute popped. When plane caught up, he found himself facing it nose-to-nose. Then it spun by and crashed. Hoover's injuries were minor. Today's answer to flat spin is deceptively simple: Avoid it.

this situation many times before.

"Feels pretty flat," he radios to Paul Stough, project engineer who is supervising the spin test monitoring station at NASA's Wallops Flight Center. "Flat" is a curiously mild word to describe what pilots consider the most dangerous spin of all: whirling around the plane's center of gravity, while dropping straight down like a maple leaf. A plane in a flat spin is no longer flying. It's turned into a plummeting box; its control surfaces are useless.

Still, Patton's voice is relaxed and matter-of-fact as he describes what is happening. "Controls back to neutral. Seventy-five hundred feet. There's the prop stopped." Centrifugal force has interrupted fuel flow to the carburetor, killing the engine.

"Sixty-five hundred. Recovery controls now. I don't see any recovery. Six thousand."

As the plane continues spinning, a flash of light flares briefly at the tail. A chute streams out. "Popped the chute," Patton reports. The chute lifts the tail. The

nose drops to a diving position. The spin stops. Patton has regained control.

"Okay, I'm recovering now." He jettisons the chute. "Restart. Forty-four hundred feet."

The "black art" of spins

NASA researchers like Patton are closer than ever to unwinding the complex mystery of aircraft spins. But spins remain a lethal problem, both in general and military aviation. Spins are a factor in approximately 8 to 18 percent of general aviation fatalities, according to differing estimates. Since the early 1960s, the Navy has lost as many as 80 F-4 and seven F-14 fighters where the cause was listed as out-of-control flight and spin. In 1980, there were at least 10 "uncontrolled depar-

tures" (most terminating in a spin), leading to three fatalities, according to the Navy Safety Center.

Experts can't always explain the complex interaction of forces that lock a plane into a stable—sometimes unbreakable—pattern of rotation toward the ground. "It's a black art," according to Chuck Sewell, chief test pilot for Grumman Aerospace Corp., who has been involved in spin research since the early 1960s.

It is known that all spins begin with a stall: The wing meets the air at too high an angle to provide effective lift. Turning left or right at the moment of the stall puts the plane on the brink of a spin. In a turn—depending on the aircraft—one wing rises higher than the other, kicking the plane into a roll. And roll, combined with yaw and failure to maintain lift on the wings, tosses the plane into a corkscrew aimed at the ground. Sometimes the plane winds up inverted in this corkscrew.

Yet most spins are fairly easy to escape. Many light planes, in fact, are designed to recover without any pilot input. Curiously, the most dangerous spin of all tends to be the quietest, and the one with the slowest descent rate: the flat spin.

In a flat pattern, which sometimes develops out of the corkscrew, the plane essentially rotates around its center of gravity and falls in a horizontal position. It can take minutes to whirl to earth. And the ride, Sewell says, is eerie and in some planes, painful.

"When the F-14 goes flat," he says, "it rotates about 180 degrees a second. The pilot sits about 22 feet forward of the center of gravity," so the feeling is like riding a centrifuge. "There are very strong eyeballs-out G forces acting on you," Sewell says. "Your blood pools in your arms and legs. It hurts like hell. It feels like a zillion hot needles sticking in you. And when you push on your controls, it hurts so much you hardly push at all." In a plane that isn't

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PM'S MILLION-

In which we take 16 of the world's most fearsome cars, two legendary drivers and Ontario Motor Speedway, add 500 gallons of gasoline, a large dose of currency, a jigger of courage and a dash of good luck, mix well and pour out the most ambitious road test ever devised.

by Rich Taylor and Tony Assenza AUTO EDITOR



Stirling Moss and Phil Hill, legendary race drivers, joined the editors for PM's test.

The Lamborghini Countach, perhaps the ultimate exotic car, is designed for sustained high-speed motoring, and isn't easily drag-stripped. It took many runs to get consistent quarter-mile times. The Ferrari 308 (below) displayed neutral handling; its engine felt virtually unburntable.

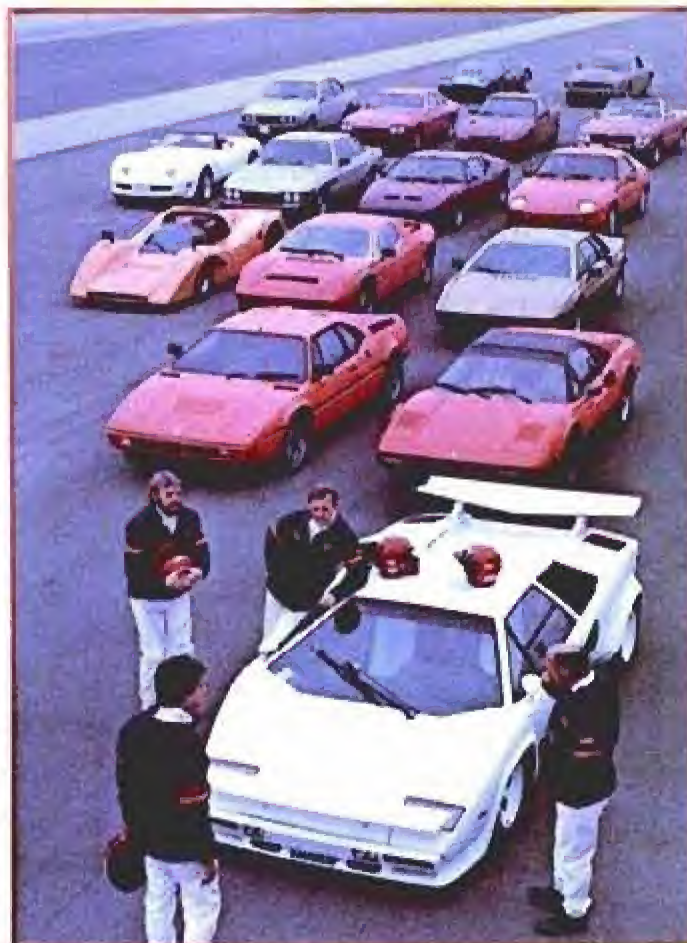
PM photos: David Gooley



DOLLAR CAR TEST



Rich Taylor and Tony Assenza tried to match Moss and Hill—and almost succeeded.



Probably the most glamorous and expensive group of cars ever gathered for a full-fledged road test, the machines (from bottom to top) are: Lamborghini Countach, BMW M1, Ferrari 308 GTSi, Manta, Maserati Merak, Lotus Esprit, Duntov Turbo Corvette, DeTomaso Longchamp, DeTomaso Pantera, Porsche 928, BMW 633 CSI, Jaguar XJS, Porsche 924 Turbo, Mercedes 380 SL, Ferrari 512 BB, Aston Martin Volante. In four days of testing, they used 500 gallons of gasoline and chewed up enough rubber to run a taxi fleet for a year.

This story started out as just a dream—every car enthusiast's dream of the ultimate road test, a wheel-to-wheel battle involving the most exotic and exciting cars in the world. As with any dream that you want to turn into reality, it takes a lot of work. And to make this particular dream come true, it also took the cooperation and effort of a lot of strangers who quickly became friends.

The Duntov Turbo Corvette, for instance, was trailered all the way from Ohio to the Ontario Motor Speedway (OMS) in California by Bob Shuler, who makes the turbo conversion. And the Mercedes 380 SL came an even longer distance—virtually going from right off the assembly line in Germany onto a plane; the car

was waiting for us at the airport when we arrived in Los Angeles.

The British School of Motor Racing even re-scheduled its racing classes at the Ontario course so we could have four uninterrupted days of testing—no small feat, considering that 12 of its

Although the BMW M1 is literally a detuned race car, it was very tractable on the street and highway loop. On the track, it was outlanding.





Helmets were fitted with microphones to record impressions as we drove. Mikes were installed by SetCom, which makes two-way radio rigs for Indy cars.

At \$16,000, the Manta kit car was the least expensive of the lot we tested. It has a space-frame chassis, fiberglass body and a Chevy V8 mounted at rear. The car was completed by owner Ken Mills just one week before the driving trials.

students were coming from as far away as Canada, New York and Michigan.

And then there's Ken Mills, who'll be receiving the PM Trusting Soul Award. Ken spent two years and \$18,000 building the immaculate Manta kit car. He put the finishing touches on it just one week before he turned it over to us for testing, knowing full well that Stirling Moss and Phil Hill would be pushing the car to its limits. He was trusting and brave and a good sport for not taking it away

after we had spun it several times.

The ultimate road test needs at least one superlative driver. We got two: Phil Hill, who won the Grand Prix world title in 1961—the first American ever to do so, and Stirling Moss, who had come in second five times in the race for the GP title and is considered one of the best drivers ever to set foot to gas pedal—194 wins in 466 major auto races, mostly in the '50s. These two gentlemen are the reigning godfathers of motor racing, with credentials to qualify them as living legends.



The DeTomaso Pantera would easily smoke its tires due to its big, mid-engine-mounted Ford V8. It tripped the clock at a sizzling 96.15 mph in 14.94 seconds.



To make sure every driver drove each car and each car got a rest between test sessions, a computer was used to work up a schedule. Taylor and Joel Breault consult printout.



After three laps on the track at the hands of Stirling Moss, the Jaguar's front tires were worn quite badly at the tread shoulder. Despite that, Moss said that the car handled well for a front-engined vehicle.

The DeTomaso Longchamp, also a front-engined car, and therefore nose-heavy, ate up its front tires and eventually destroyed the left front tire on the track. Though it doesn't look as exotic as some of the others, it's fast and handled well. A wolf in sheep's clothing.



Blood-red Maserati Merak managed to turn heads even in car-jaded southern California. On the track, it just turned fast laps.



Lamborghini Countach will set you back \$115,000.



Lotus Esprit is priced at \$37,110.

HOW DO YOU BUY A CAR THAT COSTS MORE THAN A HOUSE?

Assuming you're not in a position to pay cash for an exotic vehicle, what are your chances of driving a car like this? Pretty good, actually. The secret is "high residual value." In other words, these cars are so rare and so much in demand that most of them actually *increase* in value over the years. Heads-up bankers, like the Maryland National Bank in College Park, will lend money with an exotic car as collateral, because they know they can get their money back if you default.

Leasing is popular with exotic-car dealers, because they count on making 20 percent more from a lease deal than an outright sale. That's another way of saying that a typical lease will cost you 20 percent more than a purchase. The advantages are that leases on expensive cars are now generally for up to six years with comparatively small monthly payments, the dealer has a vested interest in maintaining the car, and the only front money needed is two months security in advance.

Conditional sale is an increasingly popular gambit that most banks mistak-

only call a lease. You pay 10 to 20 percent down, then finance part of the rest as a lease with maintenance plan, with a balloon payment at the end after the car is resold. The advantage is lower monthly payments.

Balloon notes are the nearest thing to financial magic. You front a 10-percent down payment, then finance the rest for a year or two, promising to pay the entire principal when the note comes due. Your small monthly payments are only for the interest, not the principal. At the end of the term, you can either "roll over" the note once again, or sell the car to get the money to pay off the principal. If you pick a car that appreciates in value, you can actually drive for free on a balloon note.

Personal tax benefits depend on your income bracket and deductions. In general, the more you make, the more it will pay you to buy an expensive car. A friend of mine actually saves \$6000 a year in taxes by owning a 633CSI, but only your accountant can tell you whether you'd be in the same happy predicament.—R.T.

Four days later, when all the cars and crowds had gone home, when Moss and Hill had jetted off and the ground crew had cleaned up, we were left with a stack of timing sheets, a wad of computer print-outs, a boxful of comments on tape cassettes and 80 rolls of Kodachrome.

We also knew what car was the "best in the world," and why we wouldn't buy one. We knew what's the best buy among these cars—probably among all cars—and why it's not perfect. We also had a pretty good handle on the state of the art in automobile design. And you know what? These cars are good.

Look at the test results, and you'll find that even the worst car in this group performs better than 99 percent of other cars you can buy. Indeed, the worst-performing car in our test is generally considered the "standard of excellence" by which other cars are judged.

Of course, that's as it should be, since we're talking about 99th-percentile cars that also cost more than the others. These machines don't come into their own until three times the national speed limit, which means that 55 mph feels almost like walking. They're widely over-qualified for driving in contemporary America, but no cars are as sure-footed.

The testing took up four full days. The four of us were each equipped with a custom-made Simpson helmet fitted with a microphone that connected to a portable Panasonic tape recorder. Our on-the-spot comments form the basis for these evaluations. Each driver drove every car according to a computerized schedule, programmed so that the cars had time to cool off between drivers.

We started with a 17-mile loop on the streets and highways of Orange County that included narrow country asphalt, railroad crossings, freeways, stop-and-go traffic, a potholed dirt road and a stretch of medium-speed sweepers. This gave us a pretty good idea of what the cars would be like in everyday driving.

We went to the track and spent two days doing the performance testing—acceleration, braking, skid pad, slalom. The final day, all four of us drove the road course at OMS, rotating from car to car and recording our comments. Talk about living out a dream!

You can get used to living a dream quickly. After the tests, we drove the Mercedes 380 SL from Los Angeles to San Francisco for the weekend on winding California 101. There's one spot north of Monterey, where the empty highway straightens out for a mile or



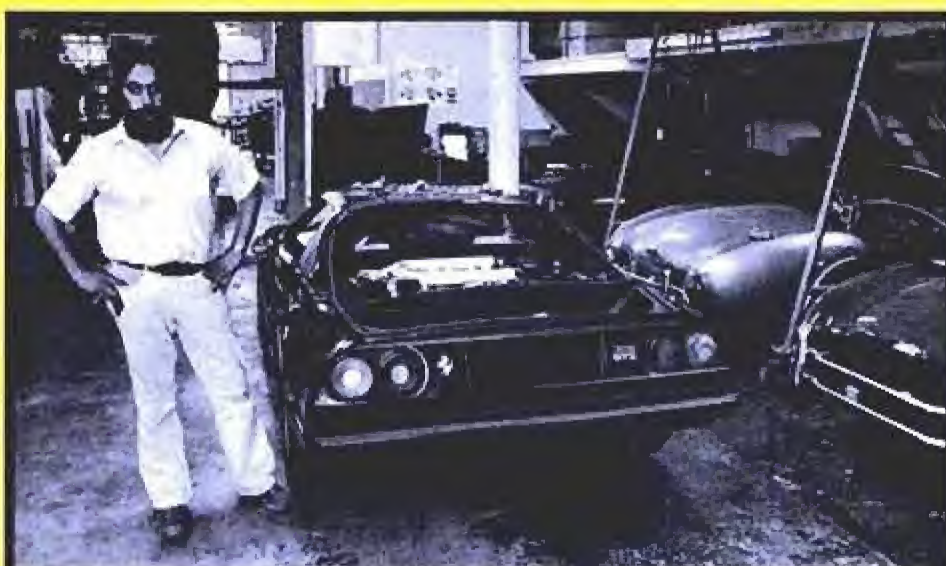
That's not a cop (top). That's PM's Dan Coleman clocking terminal velocity on a Kustom Signals radar gun. Ron Swartwout (above) from British School of Motor Racing did all of the lap timing.

more and runs right down along the Pacific. The sun was shining, the top was down and the surf was pushed by a storm out at sea. For a brief moment, we let the SL have its head, and then we realized: "It doesn't get any better, does it? This is the dream. This is it."

Pantera GTS

Talk about a surprise winner: Throughout the testing, nobody really gave much thought to the Pantera GTS. The basic mid-engine design—adapted from Georgetto Giugiaro's Mangusta—the 5.7-liter American Ford V8, even

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GETTING YOUR CAR FROM DOCK TO DRIVEWAY

Automotive Compliance Inc. or ACI, reworks European-specification exotic cars to meet American emissions and safety regulations. The company ends up remanufacturing these cars into something very different from what it started with. Here's how Jas Rarewala, the president of ACI, explains it.

"In order to bring the car into the States, we must post a bond with Customs for the full value of the car plus 2.9 percent. Only after the bond is posted can we move the car off the docks. We have 90 days from the time the bond is posted to make the car legal and submit documentation to Washington. If that documentation isn't received, they have the right to liquidate the bond and seize the car. If you can't provide them with money to ship the car back, they have the right to destroy it—which means you're out both the bond and the car.

"A 1981 Ferrari 512 Boxer takes us the longest—about 500 man-hours. To

meet the California EPA emissions requirements, we remove the existing carburetion and replace it with a complete fuel-injection system we build ourselves.

"While the engine work is going on, we completely strip the car. The steering column has to come out so we can install a key sensor next to the ignition switch. The seats and instruments have to come out, and we replace the speedometer with one that reads to 85 mph maximum. We have to reinforce the frame, front and rear, to absorb impact loads.

"We have to build a whole new bumper system because the originals are just cosmetic shields on most European cars. We try to make it look the same. On the BMW M1, for example, just the tooling costs for the new nose adds \$4000 to the price of each car."

It's no wonder these converted exotics cost so much. Yet, even at these prices, most of ACI's customers pay the full tab with a personal check.—R.T.

PM's EXOTIC CARS—TEST RESULTS

CARS	1/4 MILE (sec. @ mph)	SLALOM (sec.)	SKIDPAD* (cw/ccw sec.)	BRAKING 70 mph to 0 (ft.)	LAP TIME (min.)	FUEL ECONOMY (mpg)	PRICE (U.S. \$)	PERFORMANCE (points)
Pantera GTS	14.949 @ 96.15	8.91	12.59/12.83	166.6	1:55.9	15	60,000	19
BMW M1	14.657 @ 97.40	8.71	12.46/12.59	181.1	1:54.1	10	115,000	28
Porsche 928	15.766 @ 88.75	8.98	12.83/13.19	170.1	1:56.8	11	37,930	36
Lamborghini Countach	14.994 @ 96.25	8.79	12.85/12.79	184.1	1:55.5	7	115,000	40
Ferrari 512 Boxer	15.002 @ 95.54	9.00	13.26/13.22	129.2	1:57.2	8	100,000	41
Ferrari 308 GTSi	15.950 @ 87.63	9.49	13.00/13.43	158.5	2:03.0	14	52,500	45
Porsche 924 Turbo	17.197 @ 78.67	9.19	12.78/12.87	178.1	2:03.4	21	27,500	46
Dunlop Turbo	15.758 @ 89.02	9.21	13.00/13.49	173.1	2:06.3	14	37,500	48
Mazda	15.247 @ 91.18	9.10	13.41/13.54	171.4	2:04.9	16	25,000	49
Maserati Merak	16.543 @ 85.22	9.12	13.01/13.48	167.5	2:04.1	10	41,000	53
Lotus Esprit	17.888 @ 76.92	9.38	12.98/13.24	199.9	2:04.7	16	37,110	63
BMW 633 CSI	16.795 @ 83.17	9.67	13.36/13.74	180.6	2:06.4	19	33,645	66
Jaguar XJS	16.659 @ 83.25	10.17	13.78/13.80	166.7	2:03.3	9	30,000	67
DeTomaso Longchamp	16.825 @ 86.62	10.42	13.03/13.32	237.9	2:01.8	12	69,000	69
Aston Martin Volante	16.859 @ 85.65	9.90	14.16/14.12	176.2	2:02.3	11	97,950	70
Mercedes-Benz 380 SL	18.054 @ 75.18	9.89	13.38/13.34	191.2	2:09.2	18	38,993	74

Most of the results need little explication, except to point out that the overall performance points were awarded like a golf score: the lower the number, the better the score. Overall performance points were based on all test factors, including fuel economy. Price, too, was factored in: one point for the Mazda kit car, 15 for the M1 and Countach, tied for most expensive. In the slalom, for instance, the M1 came in first at 8.71 seconds and received one

point. The Longchamp came in dead last and received 16 points. Every car's ranking in each test was then tallied up.

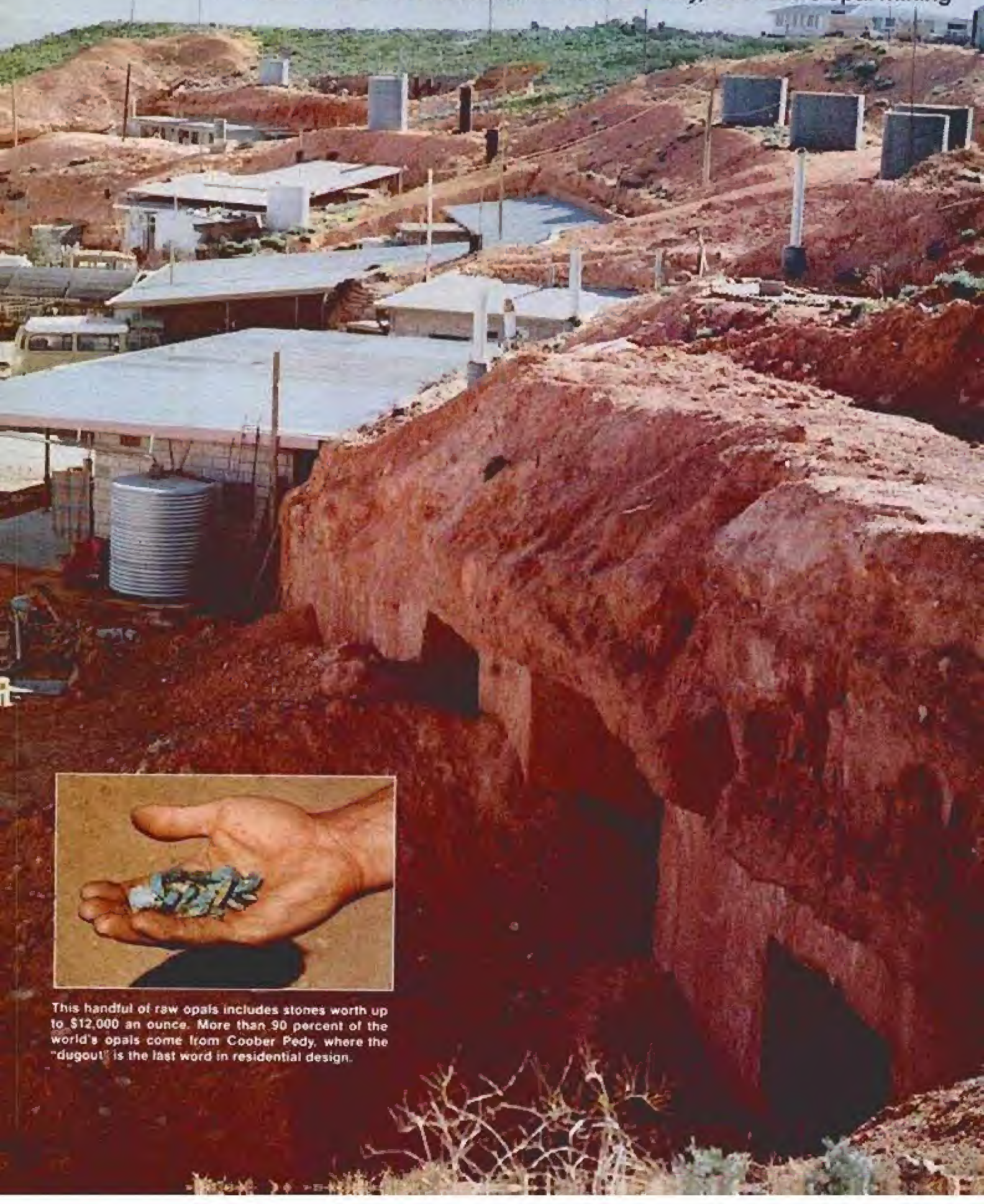
The slalom test used seven cones spaced 100 feet apart.

*Skidpad was a 200-foot-diameter circle: the two numbers indicating clockwise (cw) and counterclockwise (ccw) runs, respectively.

Lap time is the fastest lap of the day by that car.

THE TOWN THAT

It can hit 150° in the streets of Coober Pedy, Australia's opal mining



This handful of raw opals includes stones worth up to \$12,000 an ounce. More than 90 percent of the world's opals come from Coober Pedy, where the "dugout" is the last word in residential design.

WENT UNDERGROUND

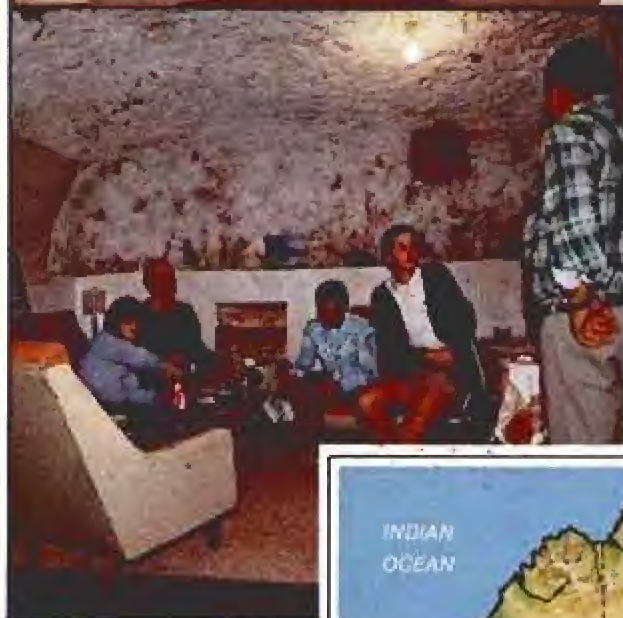
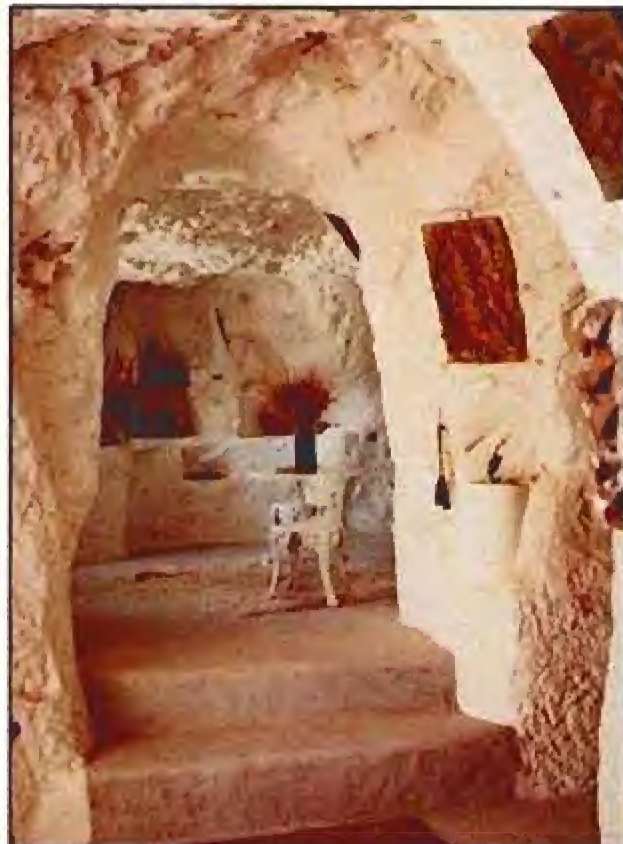
center, but the whole town keeps cool by living where it works—down under.

by Richard Dunlop

Stand up on your own two legs on the gravelly, red hardpan covering the world's richest opal deposits in the Australian Outback, and you stand taller than anything stretching to the horizon. Only spindly bushes that need little water grow on the Gibber Plains desert. A cobalt sky overhead is the dwelling place of the sun, and in the Down Under summer, which is the reverse of the season in the United States, the sun is no friend. Not long ago, for three consecutive weeks in the town of Coober Pedy, South Australia, the daily temperature in what little shade could be found exceeded 140° F. On one day, it soared to 152°, exploding the mercury thermometers left in pickup trucks and autos.

At night, the temperature dropped to around 100°. When the hot spell broke, the thermometer fell to the *usual* 120° or so at noon, and the opal miners stopped one another in Coober Pedy's dusty main street to remark about the fine cool weather. Then summer drew to an end, and the temperature sank below 100° for the first time in months. When it cooled off to 80°, people slipped on sweaters and jackets.

In such a fierce climate, the first opal miners who came and dug holes in the Outback hardpan, looking for the brilliant gems, soon learned that it was cooler underground than above. Today, of the approximately 5200 people who inhabit the opal fields, over half live in what are called "dugouts." Dwelling beneath the face-of-the-moon surface, miners find that the temperature varies only a trifle from a year-round 72°. It is not surprising that the Aborigines named the place "Kui-pa Piti," or "White man-in-a-hole," which over the years was corrupted to Coober Pedy.



Dugout homes cut into the sandstone of Coober Pedy are not without all the comforts, plus a certain free-form charm. Unsupported ceilings run up to 35 feet across, and thick walls will keep gossip at home and a loud neighbor's party contained. Supplies must be hauled (map at right) over unpaved Outback road.

In the opal workings, the desert is dotted by natural mounds up to 30 feet high. Among these are such sandstone protuberances as Ice Cream Hill, cone-shaped and colored vanilla and chocolate, which has been riddled with residences, and German Hill, so named because most of its subterranean inhabitants are refugees from East Germany. Other subsurface homes are reached through excavated clefts that are reminiscent of the Valley of the Kings in Egypt, from which one enters the tombs of the Pharaohs.

Miners plant shrubs and vines at the entrances to their underground dwellings to screen out the blazing sun. They water the precious green plants with recycled bath and dish water, because five inches of rainfall in a year is considered average.

None of this would exist except for the craze for opals which captured Australians 60 years ago with the same intensity that gold fever had seized the California '49ers. Coober Pedy miners dig 95 percent of the Australian opals, and Australia supplies 97 percent of the world's opals. The coruscating stones bring up to \$12,000 an ounce (for top quality) and range in

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Driving the Ford EXP

FIRSTHAND REPORT

by Tony Assenza AUTO EDITOR



Born of the Escort/Lynx, these new cars share

The last turn before entering the oval from the road course at the Phoenix International Raceway is a tire-grinding, decreasing-radius left-hander with an offcamber pitch thrown in for good measure. After my first exploratory lap of the track in Ford's spanking new EXP I thought I had the track figured out. I didn't.

I came into the approach way too hot, so the rear end started to race the front end into the oval.

In a situation like this, instinct tells you to jump on the brakes and slow down. But, getting on the brakes when you're going sideways will only lead to an embarrassing spin. I did what I was taught to do in racing school: Cornering 101 taught by Professor J. Besmer tells you to give the wheel full counterlock and give it the gas.

Counterlock will get the front wheels pointed in the same direction as the car. Giving the car gas will stabilize the car by transferring weight to the rear wheels, allowing them to get a better grip, and thereby stopping the slide.

Guess what? It worked.

EXP lesson No. 1: The car is very predictable. And, by corollary, very forgiving.

On many production cars, by the time you realize you're going sideways it's either too late to do anything about it or the car simply doesn't have the wherewithal to correct a mistake, no matter what saving maneuvers you employ. I'm happy to report that the new Ford EXP and Mercury LN7 both have a very forgiving nature.

That forgiving quality makes them not only fun to drive but, ultimately, make them very safe cars indeed. You can totally botch a corner, as I did, and still get enough advance warning to save it. It won't sneak up and bite you when you're not looking.

The underpinnings

What makes the car work so well is an all-independent suspension. It used to be that IRS (Independent Rear Suspension) was something that was only found on exotic sports cars. Now, thanks to the proliferation of front-wheel drive, carmakers

(Please turn to page 164)



Large cargo area has a 30-cu.-ft. luggage capacity. Retractable cover hides valuables.



The TRX suspension package adds considerable cornering ability to the all-independent base suspension. Body lean is also acceptable.

and Mercury LN7

similar mechanicals, but totally different personalities.

Crisply styled along European lines, the EXP and LN7 sit on a 94.2-inch wheelbase. The slippery shape has a .36 drag coefficient.



The only available engine is the 1.6-liter, overhead-cam four-cylinder found in the Escort. Standard transmission is four-speed manual, with an automatic optional. Instrument pod and dash are almost identical to the Escort's.

The steering wheel design and seats are unique to the EXP. The bubbleback rear-window treatment (below) is available only on the LN7. The notchback style (top of page) is available only on the EXP version. All other specifications are identical.



RVs really are smaller

Compact mini-rigs take less gas to tow or to drive.

by Bill McKeown
RV EDITOR

This looks like the year for recreational vehicles to shape up or shake out. For shoppers, it means lighter, more streamlined, more fuel-efficient, more expensive RVs. For makers, it could be good-bye to the business if their rigs and dealers don't measure up. There are estimates that the industry saw a dropout rate of 30 percent last year, but most strong brands appear to be here to stay.

Winnebago claims a major breakthrough by chopping the weight of one rig in half and more than doubling gas mileage with a reported average of 15 or more mpg on the highway. Coachmen is introducing a line of lightweights. Fleetwood has found that a new 17" front slant for its Prowler, Wilderness and Taurus travel trailers can cut drag 38 percent. It has also introduced scaled-down fifth-wheel models for use with compact pickups. Holiday Rambler is adding strength and cutting weight by extensive use of aluminum.

Most RVs carry a Recreation Vehicle Industry Assn. (RVIA) seal, indicating

that the plumbing, heating and electrical systems were built to industry standards. This tells nothing about the strength of the rig, however, and very few companies—particularly those building public buses—have done additional stress testing. Winnebago recently proved the safety and durability of its units with crash tests, and Coons Manufacturing successfully put its Diamond GT fiberglass honeycomb-panel body

units through the official static-load safety standard compression test.

Diesel is the only alternate fuel that seems to be growing in popularity, in spite of the large additional cost of the engine. Ford has a diesel front-wheel-drive chassis that claims 15 mpg.

RV weight and engine improvements aren't lowering purchase prices, but they are making it more economical to operate the rigs. **PM**



Laminated construction lightens body of the Coachmen Caper XL mini-motor home. Built on a Ford chassis, the 20-footer has six-cylinder power, rear dinette plan.



Even fifth-wheel trailers are getting smaller for trailering with compact pickups. Prowler LT model is new from Fleetwood.



Solar energy to maintain a motor home's batteries comes from two rows of cells from Free Energy Systems, Holmes, Pa. 19043.



Tell-tale slipstream ribbons, attached to Fleetwood's Prowler, Wilderness and Taurus test trailers, showed, during extensive preproduction road tests of fuel economy, how to slant front and minimize drag to make rigs 38 percent easier to tow.

and lighter this year!



Weight has been cut nearly in half to give Winnebago's new Warrior (left) and Itasca's Spectrum (above) about 15 mpg. Built on a Chevy chassis, these minis have a curb weight of 5950 pounds (a GVW of 7200), are fitted out and ready to go for \$18,000.



Trailers, too, are being trimmed down to save on weight and wind resistance. Shasta's new Ultra Light 20-footer keeps all the interior luxury features, but weighs only 2300 pounds. A 17-footer is 1630 pounds, and the 15-foot model checks in at 1460 pounds.



Only 14 feet long and small enough to be towed easily by a subcompact, Viking Mini Gasser camps two in comfort.

CAMPING
MOBI



Higher and wider headroom of family-sized tents like this Coleman model—along with the stove, lantern and cooler accessories now available—make camp outings easier and less expensive.

Big improvements for small tents

Innovations by manufacturers and add-ons by owners
are making tenting today a far more comfortable

by E. P. Haddon

For the backpacker, size and weight of tent and gear are as important as comfort inside the tent.

This experimental lightweight from Camp Trails required no fly, and tested successfully at altitudes as high as 13,000 feet.



For a trek across a desert or a climb up snow-clad peaks, on a bivouac affield or a camping cruise by boat, the choice of the most suitable tent is important. Fortunately, there are now improved designs, skillfully fabricated from very light and strong space-age materials, that can be set up quickly and will withstand rough wear and severe weather.

Tents I have tested range from a tiny, almost pocketable Early Winters model that can be erected in one minute at night in the rain, to sophisticated fabric shelters such as those produced by Jansport, Coleman, Eureka, Moss and North Face. Some of these beautifully crafted units are free-



Newest family tent is Coleman's Genesis, made of Evolution 3, a three-layer polypropylene lighter than canvas, and cooler.

standing and require no guy lines to keep them erect. And when they're used as homes away from home, camp life can also be improved with custom improvements you install yourself.

On the desert, where minimal shelters are adequate, you can choose a tent with eaves that overhang side panels of netting, which allow breezes to blow through from any direction. Net sides also allow a view of your surroundings and can serve as a photographic blind. One model of this type I tested had a foot-wide storm curtain with ties that were difficult to handle in a blow. As a result, I stitched a 1/2-inch strip of Velcro to the roof and a matching one on the curtain. It



Skis and snowshoes were used to secure this four-man expedition tent during setup with extra line in a night storm.



No guy lines are normally needed for Coleman's free-standing Backpack Classic tent. The arched roof is a good spot for airing sleeping bags.

Peaked roof of many of the A-frame models makes possible sitting-height headroom for dressing and cooking. Life inside is also more comfortable during a rainy spell. The tent is slightly larger and heavier than some pack models, but also has more storage space.



Even in the snow, a North Face pack-tent and Ensolite pad are warm comfort. Folding saw cuts up kindling quickly.



Ground too frozen for driving stakes? No big rocks around? Then secure the lines to logs to hold the tent in place.



Breathable Gore-Tex and free-standing stays make Early Winters' Starship model one of most modern tents.

When this perfectionist couldn't find the right tent, he designed and sewed his own from the new materials.

then could be closed at once, but easily withstand the blasts of squally winds. I've used this same tent without poles at timberline in the snow: Just suspend it between trees and it serves as an emergency shelter in frigid temperatures.

The latest tents come in an assortment of cheerful colors to suit your taste (and identify your location in an emergency). Choice is determined by personal preference and experience, how and where you travel, and whom you travel with. One of my hiking buddies, who never totes a pack weighing more than 25 pounds, has several excellent tents to choose from, but has made his own streamlined and ultracompact model for climbing. Boasting little headroom, this sleek little shelter has



shrugged off blizzards from atop Popocatepetl in Mexico to blows on the slopes of the high Rockies. Resting on an elbow at day's end while his tent is buffeted by winds, this man contentedly brews meals inside on a pocket-sized, alcohol stove, and usually follows dinner with a relaxing sundowner sip of cognac.

Many canoeists, kayakers and backpackers currently favor the popular dome tents. These boast advantages over conventional pyramid and A-frame designs. External frames of fiberglass maximize the livable and usable space inside, since there is no need for interior poles that interrupt the living room. And topping any list of dome-tent assets is the fact that they can

be picked up easily and moved about to face the sun or the breeze, or to sit on smoother ground. Dome tents don't ordinarily require the use of tent pegs, but usually come with stake loops and guy-out tabs for use when exposed to excessive winds. With only four corner stakes, my Jansport dome, supported by its flexible fiberglass wands, merely sways in winds exceeding 40 mph. With guy lines attached, this same dome has easily withstood more violent timberline gusts.

Living conditions in these spacious domes are further improved when you stretch a fly over the top. This waterproof



Once erected, lightweight dome like this Jansport can be moved easily to any new location. Staking down is seldom needed.



Standing headroom and 7x9-foot floor space are luxury features of Coleman's new Holiday family tent for sleeping four.

outer cover helps keep rain from penetrating, and creates dead-air insulation between the canopy and fly. It helps prevent inside condensation during cold or wet weather, and it fends off a blazing desert sun. For my dome, the fly takes only minutes to stretch over the external framework, and it is held taut by shock cords and hooks that attach to the four corner stake loops.

Tricks with tabs

Inside any tent, every item should be within easy reach. Take needle and thread and tack a half-inch strip of Velcro along the seam where the wall and floor fabrics join. Mating tabs are then cemented to your small flashlight, glasses case, plastic canteen and various ditty bags.



Select a model with flow-through screened ventilation for a day-and-night desert tent or a photo blind when light backpacking.



An optional van conversion kit attaches to Coleman's Villa del Mar tent with hooks and loops, and to van with magnets.

Some Velcro tabs are self-sticking and most instant glues work well, or they may be stitched in place on small bags. Usually, quality tents already have an accessory pocket for bulkier items, but a Velcro strip is ideal for anchoring small bits of gear that otherwise disappear under your sleeping bag or pack.

The loop at the top, inside most tents, is ideal for hanging a mini-light or candle lantern and serves well for drying socks. Its laundry capacity is much increased, however, if you rig a wide hanger with a twig and a length of the line you should always have along.

Cooking inside

The spaciousness of the dome tent makes inside cooking possible with a backpack stove during bad weather. Good ventilation, however, is *absolutely essential*, and even flame-retardant nylon must be protected from fire or excessive heat. The stove should be placed on a flat rock, if available, but I prefer using a small piece of 1/4-inch plywood that I've enameled and carry in my pack. It holds the stove, plus pot and utensils, weighs only a few ounces, and also serves to keep a hot stove from sinking out of sight when cooking in snow on the trail. With the new freeze-dried foods that merely require hot

water, tent cookery can be a simple process. Housekeeping tent gear should include a small sponge to wipe up any spills.

Fixing leaks

To prevent the occasional small leak that can occur in even the finest tents, apply a seam sealant like Kenyon's K-Kote at least once a year. First, clean soiled nylon surfaces with alcohol. If necessary, then apply a small bead of sealant along all seams, including the fly. Sealant is most effective when applied to the coated side of the fabric, and is also useful for parka, backpack and jacket seams.

For tent customizing and patching, I also carry Coghlan's nylon repair-tape kit. By rubbing a strip over a cut or tear in a nylon tent wall, sleeping bag or garment, I make a strong, quick repair. Patches hold better when you round their corners.

Modern free-standing tents don't usually require tent pegs, but I carry several types for gusty conditions. For kayaking campsites on soft and sandy beaches, I have four 12-inch Cyclocac stakes; in firmer ground, I use long, almost-weightless aluminum nails. For each tie-tab on your tent, you should also have a 12-foot length of nylon line to secure to rocks or trees.

Cold camping

In snow, tramp a firm and level base. Then tie the tent perimeter to a frame of saplings, if available, to prevent sinking in the drifts. In a blow, use deep-driven tim-



Light, 8x12-inch trays of enameled 1/4-inch plywood safely support a backpack stove, plus hot cups and pots for tent cooking.

bers, fluked sand and snow anchors, or buried skis or snowshoes to tie to.

Modern expedition tents have adjustable vents near the peak to allow adequate ventilation if you are cooking inside. A vestibule entry provides a place for you to leave muddy or icy boots, but you should also carry heavy-duty plastic bags. With any tent, they can hold wet gear until it can be hung out, after a storm, to air and dry.

With modern gear, plus some ingenuity, any season now is perfectly fine for tenting.

FM

by Tom Gibson

Whether you end up off-road on purpose or accidentally, it's easy to get stuck occasionally in mud, snow, sand or gravel. A winch can make getting out comparatively easy, and a manual model works well for a lot less money than a power winch. For about \$97, you can put together all the gear necessary for such an emergency in a package that can fit in one corner of your car trunk. It will have a 4000-pound capacity, but for \$144 you can double that to a heavy-duty 8000 pounds.

And there are even more advantages than just convenience and price. Your manual rig is easier to use with cars since it doesn't need a special front-end mount, is not exposed to the elements, stows easily and can pull a vehicle forward or backward.

My standard winch rig is made up of a two-ton-capacity power pull and 1/4-inch steel cables in 12-, 30- and 70-foot lengths, for a total of 112 feet. Power pulls can be found in most hardware and discount stores. They usually come in one- and two-ton capacities and, since both cost about the same, it makes sense to buy the two-ton model. I use one made by Mule-Mate.

Hardware stores also carry the 1/4-inch cable, 18 cable clips, six cable thimbles and six size-D hooks required. Have the store cut the cable into the lengths suggested. For the heavy-duty winch, use 162 feet of cable in 12-, 50- and 100-foot lengths, and add a 16,000-pound-capacity pulley block. These are available from 4wd mail-order houses; I got mine from Dick Cepek Inc., South Gate, Calif.

A bead of weld applied to each cable end will prevent unraveling. Slip a thimble through the eye of each hook and thread a cable around the thimble and back about seven inches. Attach a clip as close as possible to the thimble, then add two more as shown. Tighten all nuts as much as possible without crushing the cable.

To use, select a sturdy tree or pole within reach of the winch. Pull all the

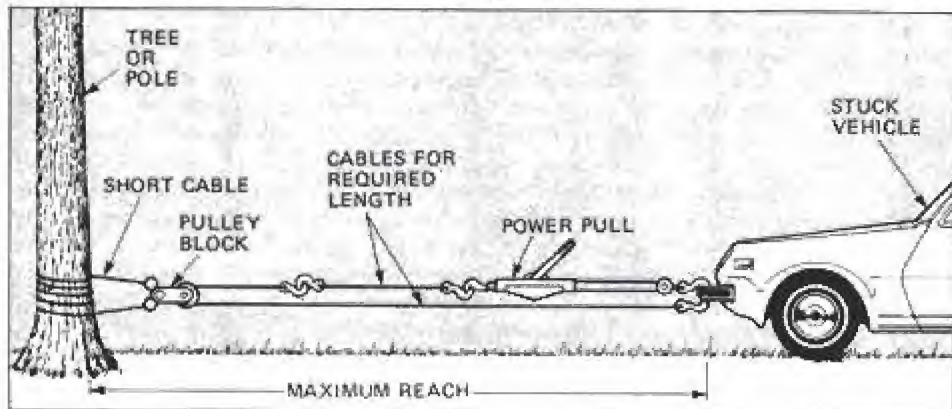
cable out of the power pull and hook up to the car frame. Avoid hooking to the bumpers or body if possible. Wrap the cable around the tree enough times to take up the slack. If the system includes a pulley block, open its halves, slip the cable over the pulley and close the halves. Crank the power-pull handle until the vehicle is pulled to safe ground.

Never use frayed cable, and don't lead one over a sharp edge or around an object and hooked back on itself. Don't use a "cheater pipe" on the power-pull handle to increase leverage; the handle is usually designed to bend before it becomes overloaded.

Components are two-ton power pull (\$40); 112 feet of 1/4-inch cable (\$36); six D-hooks (\$9); 18 1/2-inch clips (\$9); six 1/4-inch cable thimbles (\$3); total: \$97. For heavy duty, use \$29 16,000-pound-capacity block and 162 feet of cable (\$54), for a \$144 total.

Car winch for under \$100

A power pull, plus selection of a few cable lengths (below) secured around a tree or utility pole and then hitched to front or rear frame of car, can pull it out of trouble. Note cable clamps (right) are bolted with saddle against the live side of the cable, with U-bolts against cable end.



With addition of a pulley block (above), tow lines and capacity of winch rig can be doubled. Hooking on car frame is best.

Small trailers are suddenly making it big for three large reasons: they cost less, they hold as much or more than a trunk or roof rack and can be towed by any car. Even a motorcycle, snowmobile or bicycle can trail some of the lightest.

And there's an added, little-known bonus. Fuel economy tests by Dr. Ron Weiers, a professor at Indiana University and author of *More Miles Per Gallon Guide*, showed that tiny, tag-along trailers can save gas money. Towing a Coleman VersaTrailer, he found he used less fuel in his subcompact with 250 pounds of trailer carrying 750 pounds of luggage than he did with 60 pounds piled on a roof rack. In distance tests, with utility and camping trailers in tow at 55 miles an hour, the tow car needed less than one extra gallon per 100 miles of trailering.

Some models have special features and advantages. For cargo, it's worthwhile to find one with a bed wider than 48 inches and with drop gates front and rear so that a standard 4x8 of plywood or wall-board can be carried.

The utility trailer from UniTran, 1505 East High St., Jackson, Mich. has a telescoping drawbar, tilt bed, and optional winch bar and extension rails. The Apache Cub, by Vesely of Lapeer, Mich., turns the top cover into a boat. Coleman's VersaTrailer can tilt to take aboard a motorcycle or moped, mount stake sides to increase cargo space, or drop a canvas curtain from the lift-top to become an overnight shelter. Other makes open into mini-tent trailers for off-road camping out. Nearly all of them can be adapted to carry a light boat in the cargo bed or on top.

In addition to Coleman, in Somerset, Pa., UniTran and Veseley and a number of other boat and travel trailer makers are getting into the mini business.

Bremen Sport Equipment, Bremen, Ind., makes a Travel Ez. The Chariot, in a number of models, comes from Chariot Manufacturing, Oldsmar, Fla. Space Accessories, Atlanta, Ga., produces the Slipstream. The Weekender Tent Camper is from Economy Traveler, Kendallville, Ind. Holsclaw Bros., Evansville, Ind., has the A-5 Compact. Owens/Classic, Sturgis, Mich., makes a Mighty Midget kit. Li'l Pup is from Shoreline Trailer Sales, Arlington, Tex. Spartan Products, West St. Paul, Minn., makes the Back Packer. Time Out Camper comes from T.O. Corp., Elkhart, Ind. Le-Trunk is by U.S. Trailer, Livonia, Mich. **FM**

Five compacts from Chariot include a 13-foot Sun sleeper for camping, plus models to carry motorcycles, sales stands, cargo.



Tiny trailers for compact cars



Any trailer can be a camping model if it's large enough to hold a tent and gear. The VersaTrailer from Coleman, with removable top, adapts to other cargo chores, as well.



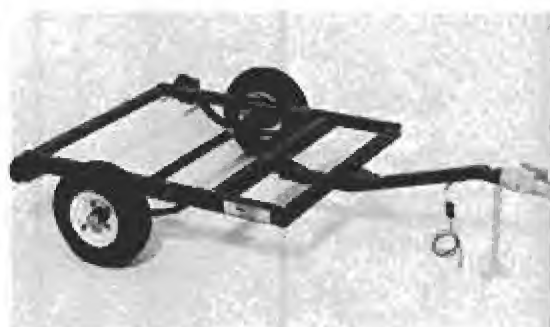
The Weekender can open into a camping tent trailer sleeping two, but only has a 25-pound tongue weight.



Hitched behind a motorcycle or mini, the Holsclaw Compact A-5 Trailer has 20-cu. ft. capacity, can carry up to 500 pounds.



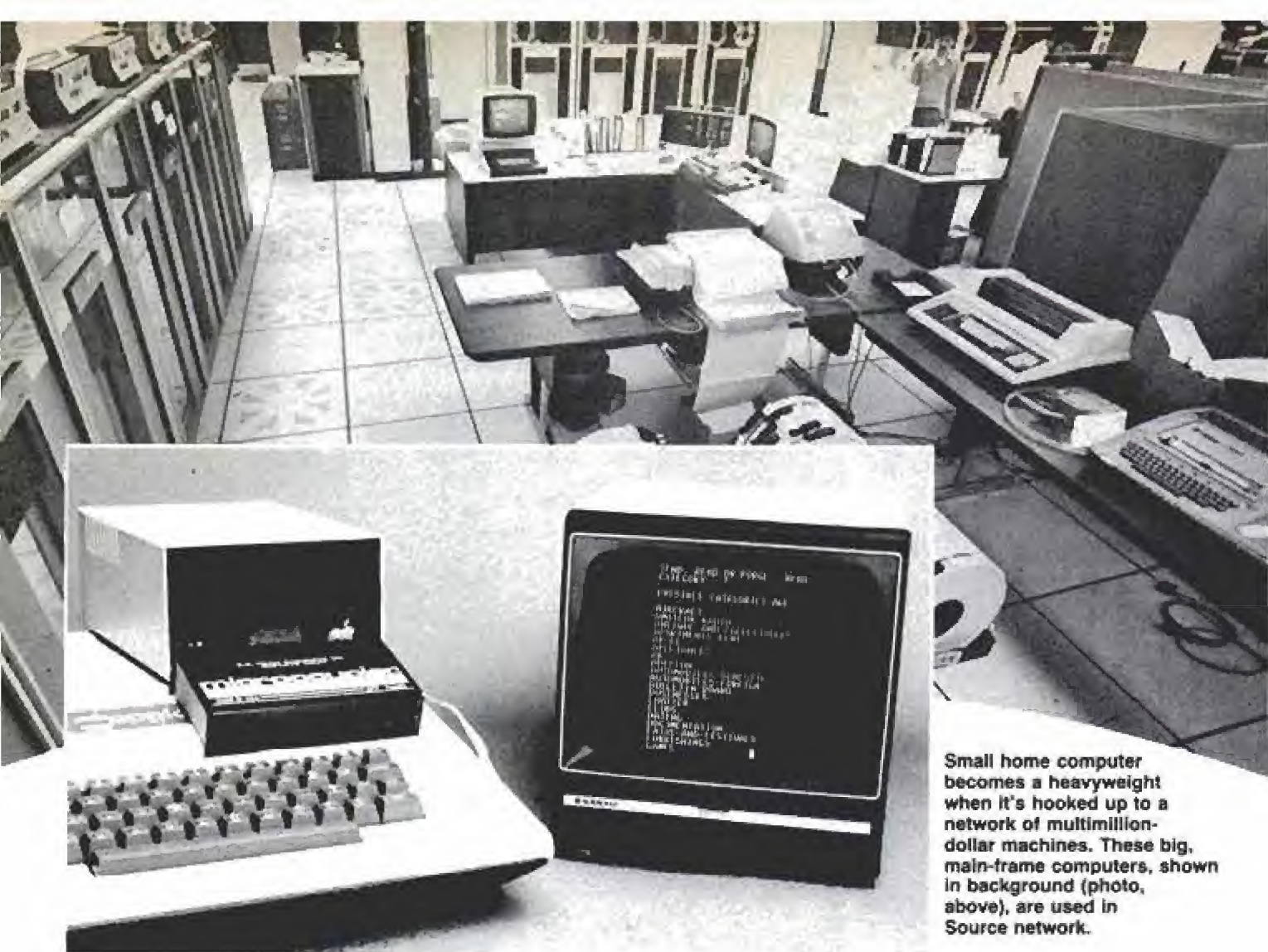
Aerodynamically shaped to ride behind a compact car, the fiberglass, waterproof Slipstream is from Space Accessories.



The Mighty Midget trailer-in-a-box comes as a bolt-together kit that you take apart for storage. It's from Owens/Classic.

Time Out Tent Campers, in 550-pound and ultralight 470-pound models, open out to sleep four, but fold easily to a four-foot width for motorcycle or compact car towing.





Small home computer becomes a heavyweight when it's hooked up to a network of multimillion-dollar machines. These big, main-frame computers, shown in background (photo, above), are used in Source network.

Now your home computer can call other computers on the telephone

Now, for just the price of a local telephone call, you can hook up your own computer to giant computer networks and to other home computers—to provide access to an absolutely staggering array of information.

by Neil Shapiro ELECTRONICS EDITOR

I sat down at the keyboard of my personal computer and, as words scrolled onto my TV set, I read the next day's newspaper stories. I was viewing the news "hot off the wire," even before most editors could see it at the local newspaper office.

Later that same evening, I decided to second-guess my travel agent. The agent had told me there was no New York-to-Chicago flight scheduled near the time I wanted to leave.

A few touches on the computer keyboard brought a complete airline schedule onto the screen. Sure enough, there was a plane that would serve me, and I wrote down its flight number so the agent could reserve a seat for me.

This was no multimillion-dollar computer system I was operating. It was simply my home computer, an Apple II, plugged into the telephone jack on the wall and communicating

with a very large computer network.

Computer networks have existed for years, but until recently, they have been used only by large businesses and universities. Such a network is composed of computers all over the country that are connected by phone or cable linkups, enabling them to share information.

If one computer in the network is accessed, say, in New York, it can funnel information from any other computer in the network, coast-to-coast. The telephone charges to the user are based on the *nearest* computer in the network.

Hourly charges are very high during business hours. But now, there are at least two organizations, the Source and Micronet, which offer low "off-peak" rates to the computer hobbyist.

The flagship data base on the Source is the entire United Press International (UPI) news wire. The UPI data base lets you read the news even before the local editors.

You can even use the computer to search for news stories in any category you want. Just enter a word—such as "elections"—and all the stories containing that word will be dis-

There are data bases on the Source for just about anything you might want. We used almanacs, astrological forecasts, stock-market quotes, games and many others.

People on the other end

The Source and Micronet both feature electronic bulletin boards. Public notices range from "for sale" notices to information on antique-collecting clubs, or any other conceivable interests (though both the Source and Micronet screen the messages for objectionable language or content).

Many businesses are using this new, instant mail to keep their salesmen in contact with the home office. Other users are simply hobbyists exchanging notes.

Micronet offers a "CB Simulator." Just as on citizens band radio, there are 40 "channels." Any number of computerists can be on one channel, all talking (typing) together simultaneously.

Here comes the software

Micronet sells computer games, educational software and business and home programs that work on all the major home computers. But



there is free software available,
too.

Many Micronet user groups (clubs) can help you get the most out of your home computer, whether it's an Apple II, TRS-80 or Heathkit machine. You can also exchange programs with other club members right on the network.

A small world after all

The world of computer networks is enormous, but you can also call other small home computers. There are now hundreds of private computer bulletin-board systems (or CBBS) being run—for free—by private individuals.

All it takes to set up a CBBS to reach a few thousand other computerists is a telephone and a computer. Just combine these two with the willingness to make your system available, on a daily basis, to callers from all over the country and the world.

Such private services allow people to leave messages, read messages, and even talk on schedule to another caller. The most frequented bulletin boards may have hundreds of inter-related messages and may have been called thousands of times.

A drawback to the small system is that it isn't part of a network. If you are in New York and call a system in Los Angeles, you pay for the call. The actual computer time, however, is free.

There are many special-interest

(Please turn to page 150)

FEBRUARY 1981 131

D. J. Nisbet, Department of Biology, University of Maryland System, College Park, MD 20742

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TERMINAL MODE
To generate DATA CAPTURE type
Control "0" and then Control "1"
*****
500-1
*****
1991 DATETIME: 15-06-1991
1991 "001" OK "001" AT ANY TIME
*****
HALLWAY (N) SECTION (N) OK STAFF (N)
*****
1991 "001" OK "001" AT ANY TIME
*****
1991 GEN (N) OK 1991 (N) OK STAFF (N)
*****
1991 "001" OK "001" AT ANY TIME
*****
1991 "001" OK "001" AT ANY TIME
*****

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UPI news wire is the prime data base on the Source. You can keep up with all the news, all the time, without buying a newspaper or leaving your own living room.

RIND DEMOCRATIC CONVENTION DELEGATES TO
 VOTE FOR CANDIDATE UNDER
 WHOSE BANNER THEY WERE THROWN HOTEL AND
 IS EXPECTED TO BE MOST
 HOTLY CONTESTED ITEM AT CONVENTION
 IN MARCH OF NEXT YEAR
 VOTES UNANIMOUSLY TO CLEAR SEN HOWARD W
 CAMMON OF IMPLICATIONS
 HE ACTED UNETHICALLY IN FINANCIAL DEAL IN
 GS IN HIS HOUSEHOLD
 HOWARD W CAMMON DEPT REPORTS INDEX
 OF LEADING INDICATORS
 ROSE BY 2.5% IN JUNE IN BIGGEST MONTHLY
 Y INCREASE SINCE JUNE

Once Micronet's *Columbus Dispatch* data base is entered, stories are displayed one after another. The Source offers a unique scanning function by subject.

```
FOR ITS CONTENT.
KEY <ENTER> FOR NEXT PAGE
CONFUSERVE PAGE 68
THE COLUMBUS DISPATCH
1 TOP NEWS BRIEFS
2 US/WORLD NEWS
3 LOCAL/CHGO NEWS
4 POLITICAL CAMPAIGNS
5 SPORTS
6 BUSINESS
7 OPINION/EDITORIAL
8 LEISURE/ENTERTAINMENT
LAST MENU PAGE (KEY DIGIT)
OK M FOR PREVIOUS MENU
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Micronet offers the *Columbus Dispatch* as an electronic data base. Pick the section in which you're interested, and then simply page through the stories.

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TERMINAL MODE
To Reorder DATA CAPTURED into
Control and the Control 'x'
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
ARTISLOGY LIBRARY
DATA ACCESS-LIB
AMONG FINANCIAL SERVICES
DATA RES
BRIDGE ACCORDING TO INNOVATION
DATA BRIDGE
BUSINESS & FINANCE
DATA BIZ/EX
CLASSIFIED RES & MULTIMEDIA
DATA CLOCK
CONSUMER INFORMATION
DATA CONSUM
CROSS & ASSOCIATES
INFO X ASSEMBLING
DYNAMIC OUT WASHINGTON, D C
MEXICO
NEW YORK CITY
HYPER-CD
DATA/CD/ CAPTURING DATA IN 2000 X 2000 X

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Displayed above are a few of the data bases offered on the Source. Each data base contains a tremendous wealth of information covering a variety of subject areas.

4 easy pieces—



- 1** Plant container/bench combination is an eye-pleasing, functional setup that will improve the looks of most decks. Unit surrounds a post.
- 2** Clean lines of planter let the plants inside steal all the applause. For appearance, clear kiln-dried redwood was used throughout.
- 3** Redwood planter can be used on outdoor deck or entryway, but is handsome enough to serve as a container for large tree inside.
- 4** This good-looking and practical roll-around container, intended for large indoor planters, was designed by PM reader Harold S. Hodge.



planters you can build

Three are made of redwood; the fourth is a roll-around base to be used beneath a heavy interior house plant.

One of the quickest and least expensive ways to upgrade the looks of your home—indoors and out—is by adding a handsome planter or two. Three of the four designs shown can be used in either place. One, because it features a built-in bench, is intended solely for patio use.

Idea No. 4 is a clever, caster-mounted stand that is ideal for use beneath heavy house plants. Using it makes it a snap to move small trees and the like to sunlight, or for cleaning purposes.

Which wood to use?

California redwood is an excellent choice for planters. It boasts the unbeatable combination of natural beauty and good durability. Redwood is resistant to decay and to attack by insects. To determine durability against such attack, redwood is graded by its color and other factors. The reddish-brown heartwood from the inner portion of the tree contains extractives which render it durable. The cream-colored sapwood that develops in the outer growth-layer of the tree, like most whitewoods, doesn't have the same degree of resistance to decay and insects as the heartwood does.

When building a planter, choose one of the all-heartwood grades, such as Clear All Heart, Select Heart or Construction Heart. There are also grades available containing some sapwood, which run slightly lower in cost. These are available on special order from your lumberyard. To get longevity from the material you buy, it should be used following certain recommendations from the California Redwood Assn.

Use the right nails

Use only noncorrosive nails to build any planter which will be parked outdoors. Conventional steel nails (common and finishing), when

wet, will react with redwood's chemicals and cause unsightly stain streaks. To prevent such staining, choose aluminum-alloy, stainless-steel or high-quality hot-dipped galvanized nails. (Note: If you use the latter, remove any nail whose galvanized surface is cracked by an angled hammer blow. When the nail's galvanized surface is broken, it rusts like any ordinary nail.)

Complete plans for all planters are shown on these pages. Construction has been kept simple and there are no exotic joints to make, and all work can be done with hand tools, if desired. After completing construction, the redwood can be left as is. But you might consider doing some finish work on the planters.

Finishes

The Redwood Assn. recommends using a water repellent on all exterior redwood. This is especially true for sapwood-containing grades. The application task is easier, and you will have a better job, if you apply the repellent before constructing the planter. Coat all edges, sides and ends of lumber. Be aware that using water repellent slows down natural weathering, but since it reduces the effects of moisture, it also protects the wood from dirt and grime. A water repellent can serve as the finish, or it can serve as the undercoat for additional finishes such as bleaching or staining.

If you do not plan to follow with another finish, you should apply a second coat of the repellent.

You can use a commercially prepared bleach to speed up the driftwood gray effect (that appears as a result of natural weathering). If you decide to bleach, read all of the manufacturer's use instructions on the label.

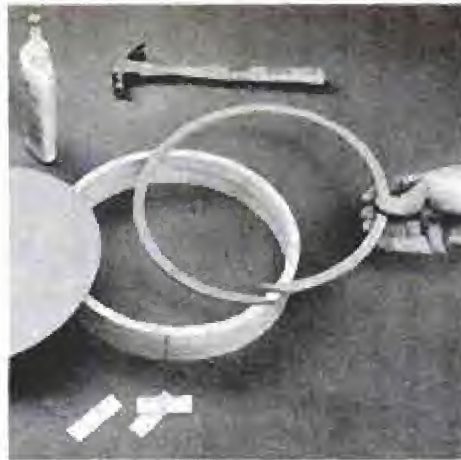
If you prefer a darker color, you will have to stain the planter. A pigmented oil-base stain can be used or you can choose a latex exterior stain. Either way, make certain the



PM photos: 1, John Rogers; 2, 3, F.B. Simson; 4, John A. Linkletter



To cut circles from block, shift the pivot point after tangent cut is made to get blade to inside. Cut forms ring and skirt.



Three pieces shown ready for gluing. The thin strips are used to fill the kerf gap.



Glue and nail the platform first, then add fillers and finish with the retaining ring.

stain you buy is intended for outdoor use. Check the label for the how-to-apply instructions.

Do not use varnish or any other clear, film-forming finish on your redwood planter. Such finishes deteriorate rapidly when exposed to sun and weather. Once it has been applied, you can bet that you will

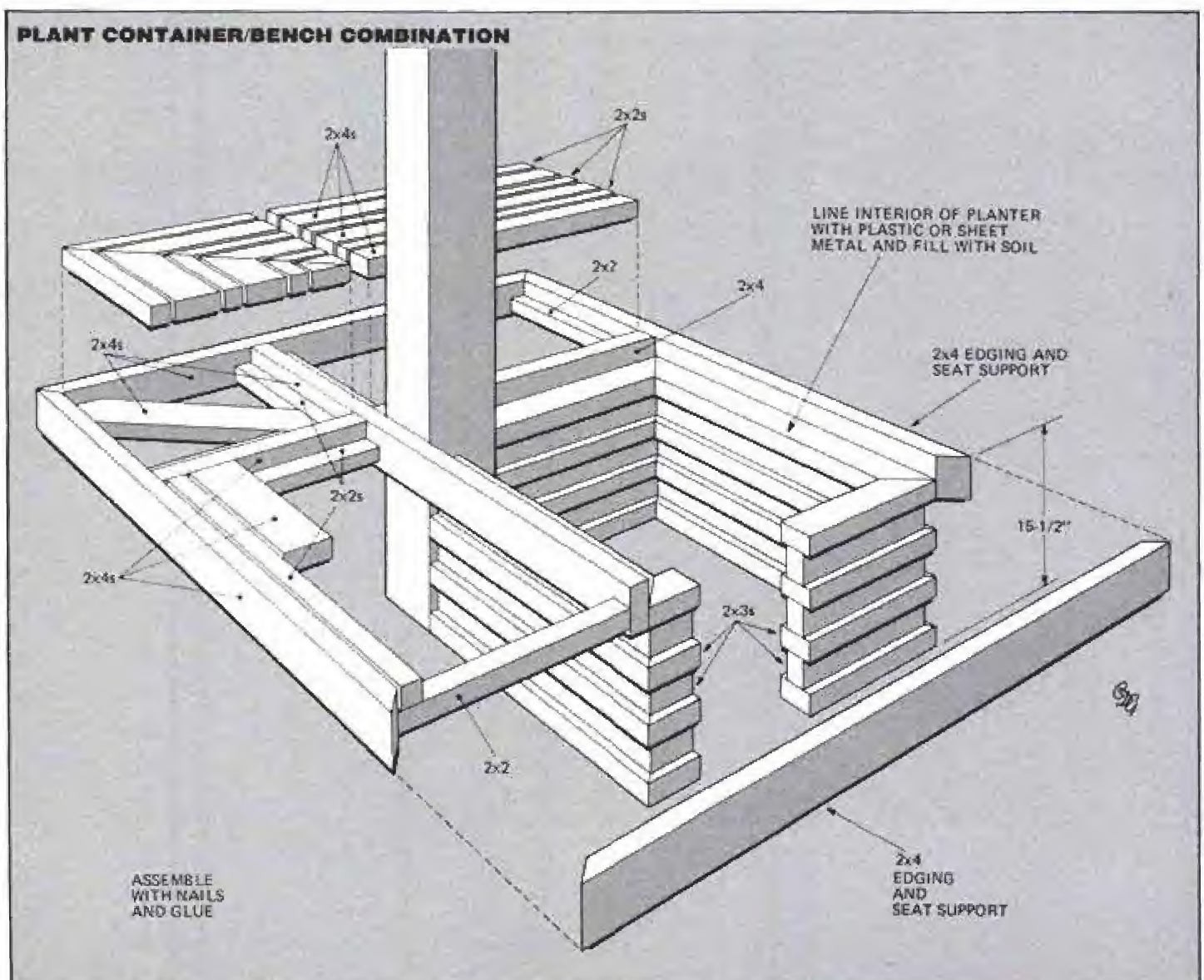
have an annual task renewing it to keep up the good looks.

Plants can be planted directly in a soil-filled planter or you can place potted plants inside. If you want the former, make certain that bushes and the like are planted using accepted garden practice. Plants, of course, must have adequate drain-

age: Too much moisture will drown a plant.

Roll-around plant stand

Dimension the stand to suit the size of your pot. You can make it by gluing up circular segments, or a block as shown. The latter permits sawing the skirt in one piece.





View from bottom: Three plate-type casters make it a snap to move a heavy planter.

Make the block by sandwich-gluing 12 pieces of wood with joints alternately overlapped. For swivel plate casters (with typical 1½-in. dia. wheels and overall height of 1½ in.), the sandwich should have two layers of ¾-in. stock with a ¼-in. layer in between. Drive nails in the waste areas to keep the glued pieces

from sliding about when the clamps are applied.

Tack-nail two pieces of ¼-in. plywood to the block, locate block center and drive a nail through and into a board clamped to the band saw (or jigsaw) table. This serves as a pivot to make a perfect circular cut. Locate the pivot the desired radius distance from the saw blade and make the cut.

Next, remove one plywood piece to use as is for the platform. On the remaining two, make a freehand tangent cut through the edge of the disc to get the blade to the inside. Reinstall the pivot and complete the internal cut to obtain a ¾-in.-thick wall.

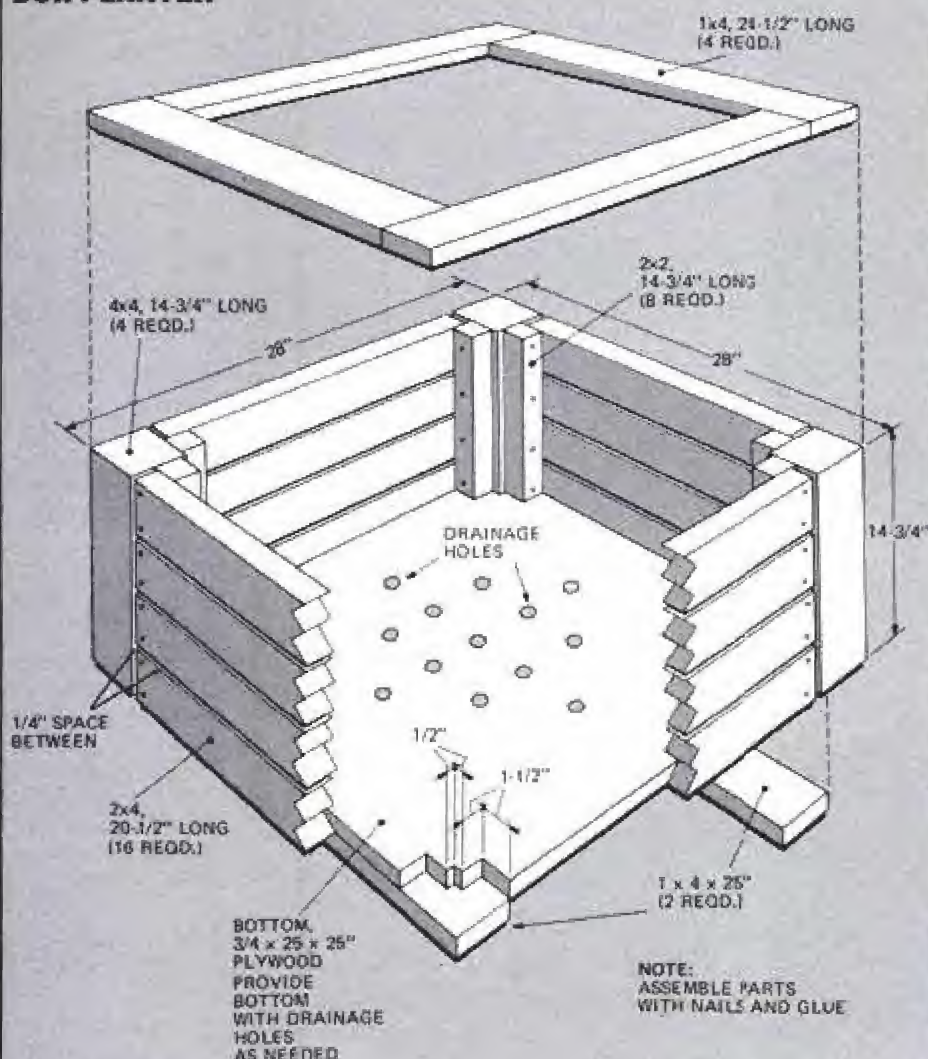
Glue the platform to the skirt, then add the ring. The spaces made by the blade are filled by gluing in thin filler strips.

Install the three casters with flat-head machine screws and nuts.

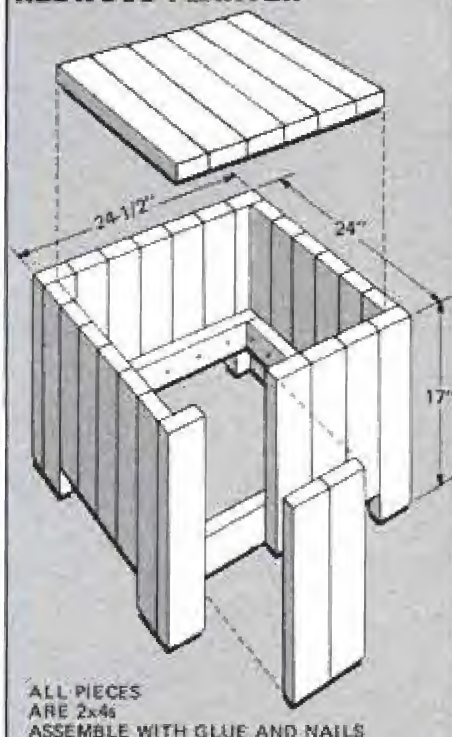
The stand shown was sanded smooth, dusted off and sealed with a coat of shellac thinned 50 percent with denatured alcohol. Next, the

surface was sanded with 180-grit paper, dusted and wiped with a tack cloth. To finish, two coats of latex semigloss enamel were applied; light sanding with 220-grit paper was done between coats. **FM**

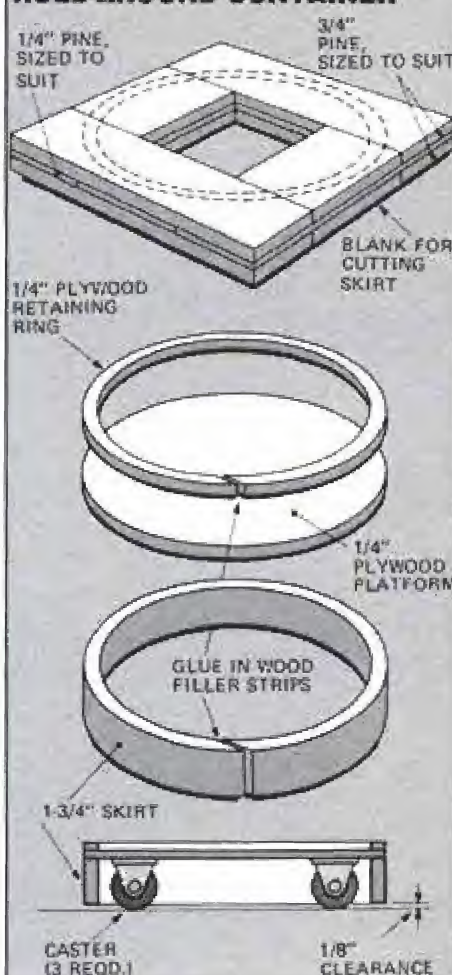
BOX PLANTER



REDWOOD PLANTER



ROLL-AROUND CONTAINER





Dick Raymond's harvest crop started as seedlings in building in the background.

Build this solar garden shed

Famous New England gardener Dick Raymond shares the plans for his dual-purpose, back-yard gardener's building.

by Harry Wicks HOME AND SHOP EDITOR

Gardening consultant Dick Raymond built the super-useful multipurpose shed below almost as an aside on an assignment last summer. Gardens for All (the nonprofit National Assn. for Gardening) asked Raymond to design, plant and evaluate the much-publicized 25×30 ft. "Independence Garden."

Dick's Independence Garden, which was designed for an average back yard, produced \$497 worth of vegetables. The garden plan and Raymond's techniques are featured in a basic vegetable gardening guide

called *Your Independence Garden for the '80s*. To get a free copy, send \$1 to cover postage and handling to Gardens for All, Dept. PM, 180 Flynn Ave., Burlington, Vt. 05401.

What PM spotted—and liked—in Dick's garden was the attractive shed shown below. It's built using conventional building techniques and a minimum of material. What's different about this back-yard shed is that it serves two purposes:

■ Its generous size lets it hold all the gardening tools you are likely to own, plus a small tractor.

■ The easy-build greenhouse lets you get started early in the season—so you are sure of an early harvest for many of the crops. You will find complete plans on these pages.

For several reasons, Raymond built his shed on skids, rather than on a permanent foundation. First, the building can be moved with tractor and cable if desired, so that ground usage can be rotated. Second, in many areas of the country a back-yard building, erected over permanent footing and block walls requires a permit. A shed on skids

Quaint building features sliding barn doors at one end, as well as a useful greenhouse that lets you get the jump on the season.

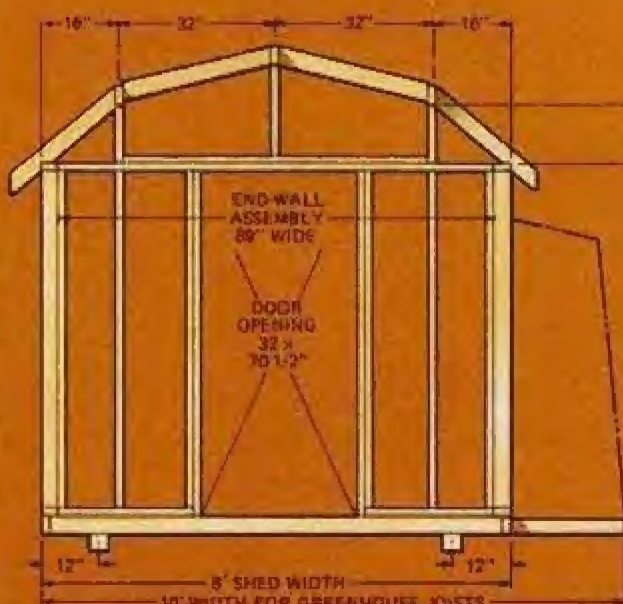




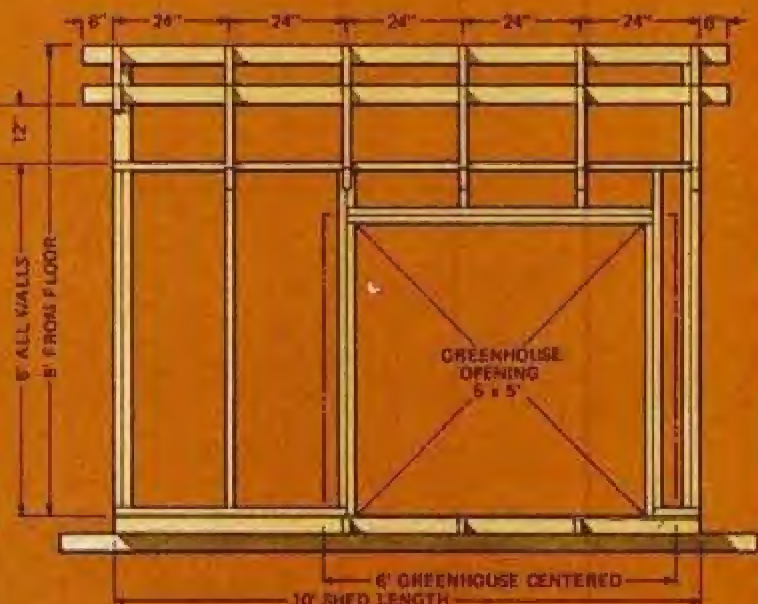
FRONT ELEVATION—SLIDING DOORS



SIDE ELEVATION—GREENHOUSE



FRAMING—FRONT VIEW



FRAMING—SIDE VIEW

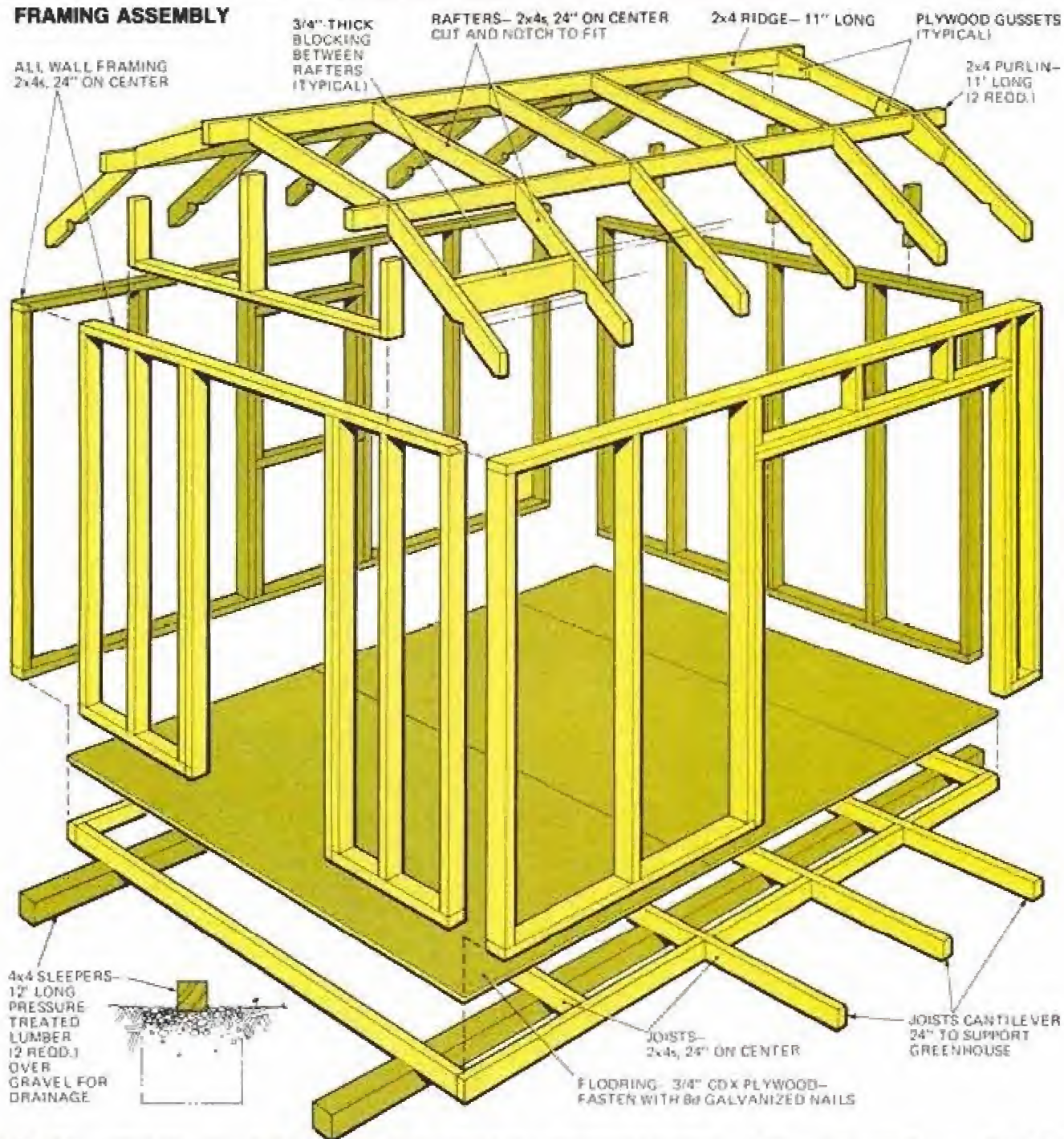


BACK ELEVATION



SIDE ELEVATION—OPTIONAL WINDOW

FRAMING ASSEMBLY



Pair of sliding doors provides an opening big enough to drive a yard tractor through.

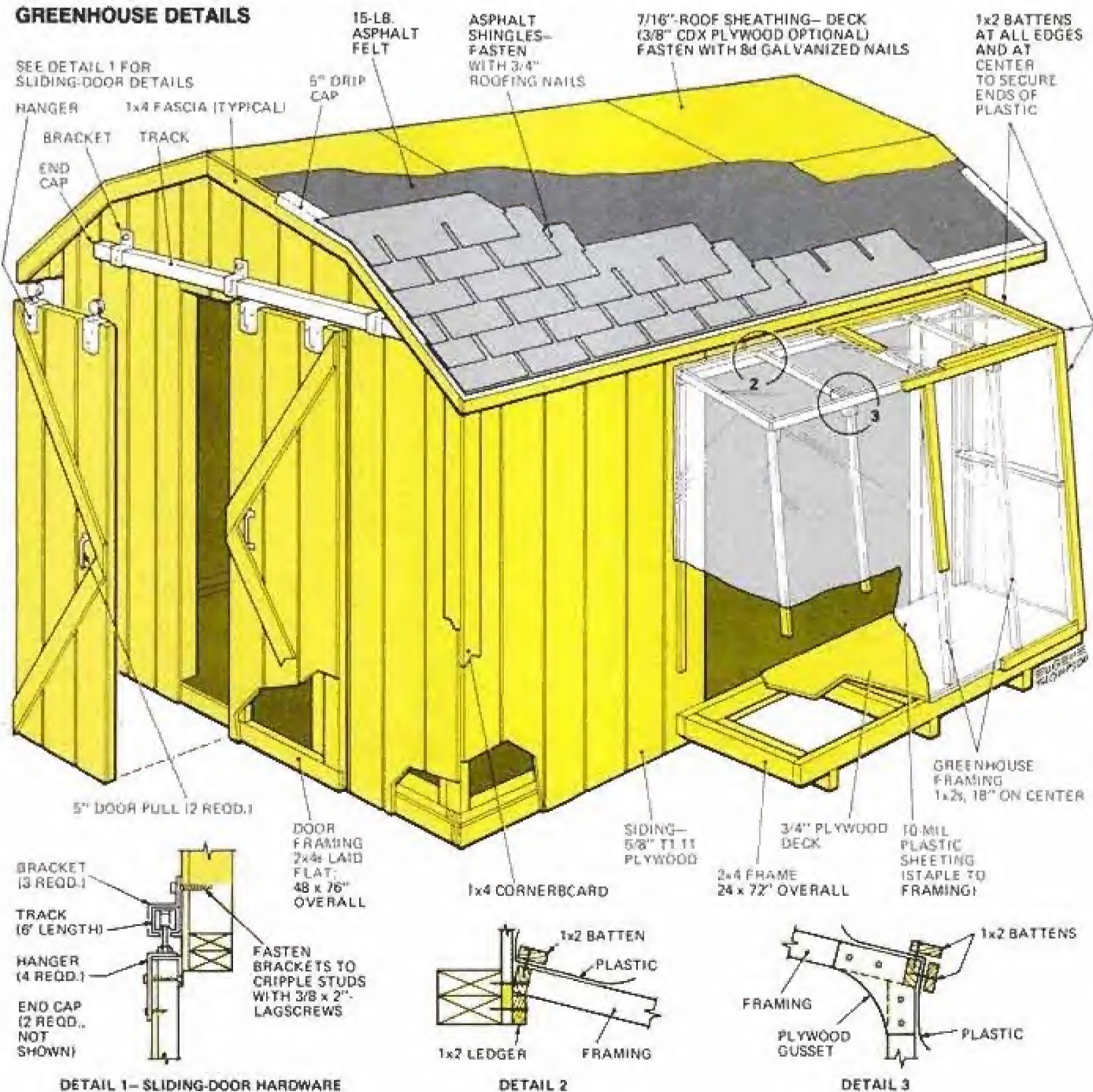


Because structure lacks collar beams, roof is beefed up with gussets over all joints.



Greenhouse is a simple structure of 1x2 stock covered with hefty plastic sheeting.

SIDING, ROOFING AND GREENHOUSE DETAILS



usually doesn't. Check your building department.

Because the building rests on the ground, Dick used pressure-treated lumber for the skids and all flooring.

Conventional framing is used throughout. The easiest way to assemble such a shed of this type is to build the floor first and use it as a work platform for the walls.

Construct the walls one at a time, tipping each up into position as it's assembled. You'll need a helper to lift the wall and hold it steady while you check both vertical planes with a spirit level. When wall is plumb, use two diagonal braces to hold it until other walls are placed.

The braces can be 1x4 material; tack-fasten them to a pair of studs (up near the wall's top plate) at one end and to a floor-mounted cleat at the other. When all walls are up, plumb and braced, join the corners using 16d common nails.

Next, frame the gambrel roof. Raymond used a ridgeboard, purlins and plywood gussets to ensure good weight-bearing capabilities. Install the two end rafter sections first to hold ridgeboard and purlins secure, then the other rafter sections.

Skin the walls with Texture 1-11 exterior plywood and the roof with 3/4-in., sheathing-grade plywood. Once the walls are covered with ply-


wood, remove the diagonal braces.

Door hardware is available at local hardware stores and from retailers such as Sears, Roebuck and J.C. Penney.

Cover the roof with overlapped layers of 15-lb. felt followed by 235-lb. asphalt shingles with self-sealing edges. Apply a coat of exterior stain to the outside of the Texture 1-11.

The greenhouse cover is of 10-mil polyethylene sheet plastic, available at lumberyards and home centers. One brand name is Flex-O-Pane.

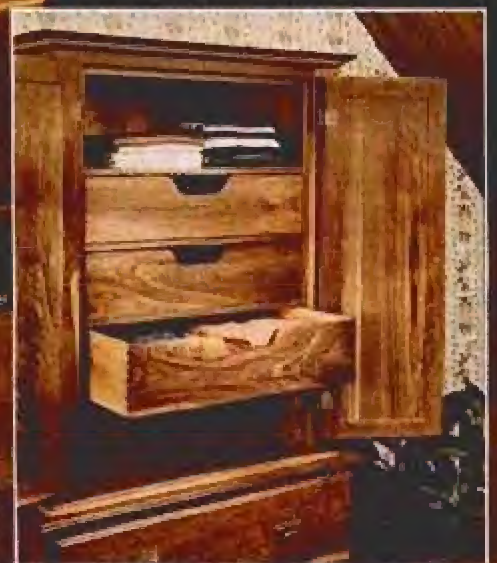
If you'd like to move the shed in your yard, install a hefty eyebolt through the end joist so you can pull it easily with cable and tractor. **FM**



This armoire was designed and built by 17-year-old Randy Begin. It took first prize in Stanley Tools' annual woodworking contest.

PM photos: Frank Rissel

Meticulously crafted in walnut, the handsome piece of furniture was a gift from the young builder to his parents. The project represents a year's work by the junior craftsman under the guidance of a dedicated shop teacher.



Wardrobe for a master craftsman

by Harry Wicks HOME AND SHOP EDITOR

Every year, Stanley Tools, one of the largest tool manufacturers in the world, stages an ambitious contest for high school woodworkers. The challenge for young craftsmen and women is to create a project of their own from scratch. They must build and finish the piece, and prepare both working drawings and a materials list. After the preliminary judging of photographs and plans, 20 finalists are

picked and their projects are crated and shipped to Stanley headquarters in New Britain, Conn., for final judging.

For the past four years, I have helped judge the finals. Without fail, each year I am impressed by the quality of workmanship produced by junior high and high school students. It takes considerable effort to become a finalist, but the rewards are consider-

(Please turn to page 180)



TECH FRONT LINES

TV in 3D: A look into the future at MIT

Ruitson Ouyang, a neurologist from Flint, Mich., came to the Innovation Center at the Massachusetts Institute of Technology with a futuristic idea. Doctors were already using computerized scanning equipment to examine human organs (with X-rays) section by section, peeling back layers of brain or kidney in successive slices. Dr. Ouyang wondered

**PM visits a
training center
for tomorrow's
inventors**

if the technique could be carried a step further, using a machine to display a living brain or other organs in three dimensions for examination from all angles.

David Jansson, MIT's Innovation Center director, had good news for Dr. Ouyang: A freshman named Ed Berlin had already designed the prototype. Using 32 light-emitting diodes spun by an old disc-drive motor, he could draw, shape and model two intersecting planes in mid-air. After seeing Berlin's machine in action, Dr. Ouyang was convinced of its eventual market-

ability. The neurologist formed TRI-VI Corp., which invested \$150,000 in further prototype development.

At MIT's center, and others created with National Science Foundation (NSF) start-up funds, students are taught to be creative technically—in a practical way. They are urged to examine market needs before they invent—to measure innovative ideas against the rigorous demands of licensing, production, distribution and, ultimately, profit.

"The marketplace always has the final say," Prof. Jansson insists. "Through the years, we've worked on hundreds of inventions, but only five—maybe 10—will make it to the marketplace."

Marketability was the intent of the NSF when it began the program and continues to be at the core. "If physicians learn their craft in teaching hospitals," argues Robert M. Colton, NSF program manager for university centers, "why shouldn't we establish a stimulative environment for potential entrepreneurs?"

Following its aim, NSF has set up innovation centers at MIT, Carnegie-Mellon, University of Utah, University of Oregon, University of Texas at San Antonio, University of Arkansas at Little Rock, and a joint center for the Polytechnic Institute of New York at Farmingdale and the State University of New York at Stony Brook. Plans are under way to establish another six university centers this year.

Eager to get the U.S. ingenuity engine moving faster to compete

with foreign innovators, Congress recently passed legislation that authorizes the Department of Commerce and the NSF to inaugurate a series of centers, similar to those now on campuses, to stimulate applied technology in existing businesses.

Legislators hope for the same kind of success experienced in the innovation center program. "Nearly 3000 students have gone through the centers," Colton says. "We've recently completed a massive survey, and our initial assessment shows that these students start businesses at an earlier age and have a greater potential for success than graduates who have no contact with the centers."

Learning from the flops

Learning the entrepreneurial ropes means learning that failures are more numerous than successes. It means gaining experience from flops and moving

INVENTIONS

on to something better. Why don't some inventions make it? David Jansson says that some fail because the idea isn't good enough; others stray from marketability because demand is too limited.

For example, here are two at MIT that missed the bull's-eye:

Inside the lid of a peanut butter jar, two pendulums—one inverted and one not—are joined by two metal springs. When the jar lid tilts infinitesimally, the inverted pendulum, pushed by the



A simple MIT bow (left and center) performs like compound bow (right).



Pendulums inside a peanut-butter jar are the heart of a sensitive Tilt Meter.



An image appears when flat light board spins. To see one 3D image, view photos (left) from about six inches while holding a piece of paper on line between photos. Keep trying until you see oval under 3D pyramid.

springs, tilts over to produce a large deflection. The device, labeled Tilt Meter, was aimed at detecting earthquakes. It was licensed, but never produced. Money-making possibilities were too limited. So the Tilt Meter met a fate similar to that of the High-Efficiency Archery Bow.

The bow looks like a giant bean pod. We tried it. When we pulled the string, a series of rubber bands began to stretch across the surface. Then the "V" of the pod split and flattened, reducing force, until it was easier to hold the bowstring in the firing position than it had been to pull it back.

This product lured AMF, the sports equipment manufacturer, into buying the license. But when an archery division folded, AMF canceled production. The bow now sits behind a bookcase in a corner of the Innovation Center office where inquiring visitors and curious students occasionally take it out for diversion.

Success Story

On the other hand, while at MIT, Ken Foster developed Thermalite insulation, a plastic mate-

rial heavily fortified with ultraviolet inhibitors. When glued on windows, Thermalite, at a cost of 35 cents a square foot, traps air inside hundreds of cellular, honeycombed bubbles. Foster estimates wholesale sales of \$55 to \$60 million by 1982.

David Jansson thinks Ed Berlin's prototype 3D display, like Thermalite, will be successful in the marketplace. He showed us the machine with its old disc-drive motor still turning the LEDs. But now 4096 are attached to a two-inch-square board. The board spins. Visual persistence shapes a cylinder. The cylinder fills with light, and 12 to 14 times each second, two million computer bits jam the LEDs. Inside the solid mass of light, individual lights flicker. The LED board sweeps the air, and suddenly a red box, pictured in total four-cornered angularity, hangs suspended in space.

The invention is complete. But only successful licensing, manufacturing and marketing will save 3D display from being tossed into the office corner, along with the Tilt Meter and the High-Efficiency Archery Bow.

Space-saving cradle

How many satellites can you fit into the belly of a space shuttle? Not many, when the satellites are laid end to end horizontally, as they were until this invention came along: A newly devised cradle holds the satellite in a vertical position, perpendicular to the shuttle's line of flight. You can pack more rectangular shapes vertically than horizontally.

Conceived by Michael Lyons, director of space segment engineering for Satellite Business Systems, McLean, Va., the cradle permits the satellite to be ejected by springs through an open bay at the top of the shuttle. Three to four seconds out, the satellite rocket fires and it's on its way.

In its first commercial use, the cradle will hold a company satellite aboard the NASA space shuttle due to launch in November 1982. (Patent 4,231,537.)

Crankless sharpener

A nonelectric, no-crank pencil sharpener is the brainchild of Jose Vila of Woodside, N.Y. Push the pencil into the hole at the top of the device. (It can be done with one hand, the patent claims.) Apply steady, gentle pressure. Cutters chew the business end, then spin free when the pencil point is sharp. The inventor says the sharpener produces a clean, sharp point.

The device employs the same action as a spiral-ratchet screwdriver. A spiral shaft spins down as pressure is put on the pencil. (Patent 4,231,405.)

Instant parsley

As if it had a double dose of space-age fertilizer, plastic greenery "grows" to three feet or more from a newly invented mold.

Patent 4,230,657 by William Haack and Dennis Peth of St. Louis covers equipment that swallows liquid plastic, molds, heats and cools it until sprouts, stems, buds and leaves appear and expand like a stalk of corn in a set of stop-action photos.

Plastic greenery has some distinct advantages over the real thing, say its inventors: It won't wilt, and bugs hate it.

RECREATION

High-tech marathon

How do marathoners feel about being computer-cataloged with a zebra-striped bar code stapled to their bib number? It's like the same close-knit set of price-code lines you find on a box of Meow Mix or on the cover of PM.

Ask any of the 12,340 finishers in the New York City marathon last October, and they'd say "Great!"

Because of the code and an array of computers, runners learned within 15 minutes of finishing two facts for which they had pounded and strained over the 26-mile, 385-yard course: their running time and place.

A week later, the mainframe computer on which all data were collected sent to each contestant congratulations on "completing the largest marathon ever scored." The printout recorded their confirmed finish place and time, plus the finish place and average time within their sex and age group.

One minicomputer—a Data General Eclipse C/350—started working out in June last year, laying down a data base from the first 10,000 applicants accepted. Another 8000 entries drawn by lottery were soon poured into the memory bank.

At a touch of a button, the C/350, housed in the Manhattan data systems firm of Personnelmetrics, spewed out demographics testifying to the makeup of the marathon: 1142 lawyers, 2000 foreign entries representing 43 countries and 4787 first-time marathoners. There was even a call for 10 extra-large women's T-shirts.

Bar codes helped keep tabs on



Finishers' bar codes are scanned.



A New York Telephone attendant (right) unobtrusively records times.

all the data and the runners. The system for using the codes was devised by David Collins, president of Computer Identics, a Boston firm. (Collins, an amateur runner himself, competed in the New York marathon and finished with a creditable 3:35.)

Three Computer Identics processors were set up in a trailer at the Central Park finish line to scan the bar codes removed from finishers' numbers.

New York marathon director Fred Lebow and Collins tested six, three-pound portable processors at the starting line to ward off potential ruses (like that which led to disqualification of a Boston marathon "winner"). Runners lining up were wanded in with light-pen scanners like so many cans of soup sailing past a checkout cash register.

Computers and a clever system sorted the runners at the finish line, where, at times, 2000 passed by in a 10-minute span. Here's how they were checked.

Three adjacent finish lanes confronted runners in the last 100 yards. Each lane was staffed with three attendants. Every time a runner passed a lane finish line, attendant No. 1 pushed a button that registered lane number and marathoner's time on an Intel SBC 86/12 microprocessor

housed in the trailer. As a double check, attendant No. 2, on the other side of the lane, pushed a similar button, recording the same data which entered an identical computer. Attendant No. 3, holding a hand terminal linked to the microsystem, entered the number of approximately every sixth runner, timing his entry to match the second the runner finished. His data spot-checked the work of the mainframe.

The trailer-housed computers stored and later sent timing information to the Personnelmetrics C/350 minicomputer. Data traveled through private lines and dial-up services installed by New York Telephone.

As the exhausted runners passed the finish line, they were led in order of finish to a checkpoint where the bar codes were stripped from their numbers, scanned and the data sent to the minicomputer. The machine merged times, numbers, name, sex, age, country and team.

Computers will be on hand next month at the Boston marathon. A microcomputer was used in as tiny a race as the 202-runner Bermuda marathon. As one systems analyst said, "There's no way anyone can record accurate time and place for a big marathon without computers."

AUTOMOTIVE

S-s-s-supercharger!

Seems everyone's talking turbo-charging these days. Since Porsche started the latest power-boost fad with its awesome winged turbo street and race cars a few years back, Saab, Buick, Mercedes, Ford, Mercury, Pontiac, Chevrolet, Audi, Volvo and Peugeot all have offered turbo-charged models. Several more makers are getting ready to jump on the bandwagon. (Ford and Mercury recently gave up on their Turbo Mustangs and Capris because that old 2.3-liter engine wasn't too suitable, but they'll likely be back soon with a turbo-charged 1.6-liter Escort engine.)

Bendix Corp. of Southfield, Mich., however, thinks it has a better idea for power-boosting fuel-efficient cars of the 1980s: the engine-driven supercharger. The idea, says Bendix, is to tune

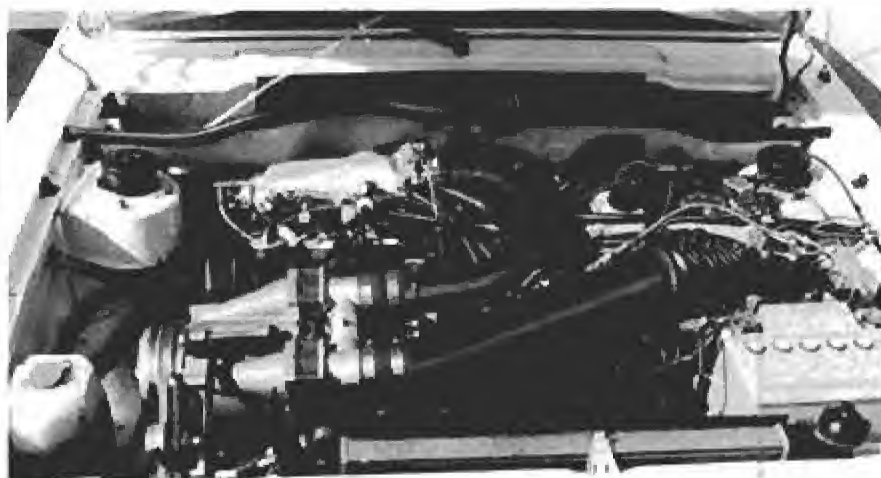
Going nameless

In the 1960s, automakers named cars according to the image they wanted to portray. That's why we got cars called Barracuda, a fierce fish, or Matador, Spanish for killer.

But now the macho animal names are becoming as scarce as cheap gas. Market surveys indicate that people don't want their cars named after fish, fowl (Skylark), quadrupeds (Impala) or atmospheric conditions (Zephyr). The current craze is for letters and numbers. So GM sells X-bodies, Chrysler K-bodies, Ford the EXP, Mercury the LN7.

What do they mean? In some cases, nothing. In others, they are engineering identifications originally intended for internal company use.

Will all car names disappear? Probably not. But marketing folks at the factories say we may have seen the last of Charger, Falcon and Hornet. Killer names, like the killer engines that went with them, are going the way of the saber-toothed tiger.



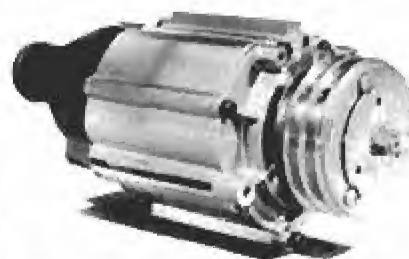
Supercharger hikes power at all speeds by kicking in extra air and fuel.

and gear a car for maximum mileage—causing a serious drop in performance—and then restore that lost performance to acceptable, even truly exciting levels with a compact, lightweight supercharger spun by an engine accessory belt.

No question the supercharger has some advantages over the exhaust-driven turbocharger. Both generate additional power on demand by forcing extra intake air (and fuel) under pressure into an engine's combustion chambers. But the supercharger does it at a touch of the throttle, even at low engine speeds. The turbo blower needs a second or two to spin up to speed (from low engine rpm) and works best at high engine speeds when the exhaust gas spinning its turbine has the most velocity and heat energy.

The Bendix supercharger is also compact (12 to 15 inches long and only 7.5 inches in diameter) and requires less complicated ductwork, no modifications to intake or exhaust manifolds and none of the heat shielding necessary for the hotter-running turbo. And, says Bendix, it is less expensive—we'd guess \$400 to \$500 at retail.

A good turbo package cutting in at 3000 rpm or so gives a solid "afterburner" kick. But no turbo-charger gets off the line from a stop without an annoying lag between throttle application and reaction. The prototype superchargers we tried in several Bendix test cars, however, made little engines pull like big ones from 0



Foot-long prototype can save gas.

mph on up. The device doesn't affect emissions and, depending how the car is geared, can even increase fuel economy.

A supercharged 1.7-liter Dodge Omni 024, for example, with its final drive ratio raised from the production 3.37:1 to a long-legged 2.99:1, managed 0-60 in a surprising 9.5 seconds vs. 13 seconds unmodified. Yet it delivered 28 miles per gallon (mpg) in the city and 38 mpg highway, compared to the production's 24 and 36 mpg, according to Bendix tests. A similar Plymouth Horizon TC-3 with a 1.5-liter VW diesel engine did 0-60 in 17 seconds—10 seconds quicker than without the supercharger—while averaging 42.1 mpg. A 1.6-liter VW Scirocco stormed to 60 mph in 8.9 seconds, 2.6 seconds faster than stock, with no significant change in fuel economy.

Bendix says several automakers interested in its superchargers are running developmental tests, but the company couldn't begin supplying the units until 1983 at the earliest because production commitments depend on firm orders.

AEROSPACE

Space barnstorming

Robert Truax's self-assigned mission seems straightforward enough: "Our goal is to pull off the first manned space flight for less than a million dollars."

Judging from successful engine tests last summer, the retired Navy captain—a rocket man since he directed the U.S. Naval Rocket Project at Annapolis before World War II—is well on his way to staging the most colorful aviation stunt since the days of the barnstormers. Next fall, he plans to use a homemade rocket, built from government surplus parts, to give a civilian "astronaut" a suborbital look at the earth from 50 miles.

Truax, the man who built the X-2 rocket vehicle for Evel Knievel's attempted jump across Snake River Canyon (the rocket worked fine, but the parachute deployed too soon), originally conceived the project to satisfy Knievel's desire to top his own feats.

"Old Evel crawled up out of the river and said, 'Bob, now what have you got up your sleeve?' " remembers Truax, 63. "I told him right then that I could make him the world's first private astronaut." Since the Snake River event, Truax has been busy buy-



Truax (inset) succeeded in kerosene-rocket test at a California airport.

ing up surplus equipment for a few cents on the dollar. With the help of a dozen mostly young volunteers, he has been fabricating the 25-foot rockets in his garage or in rented and donated machine shops.

The X-3, mounted on a trailer, looks like a short-range Army field missile. But it is big enough to hold 1,300 pounds of liquid oxygen and 650 pounds of kerosene fuel. These fuels are forced, by high-pressure helium, into the four, 1,000-pound thrust engines at the reusable rocket's base.

Truax found seven engines, originally built as attitude control thrusters on the Atlas ICBMs, in a Southern California salvage shop. Their cost in the late 1950s and early '60s was \$70,000 each. Truax bought them for \$115 apiece. "The technology we're using draws on the achievements of the '60s; that technology was good enough to get us to the moon," he says.

Not only does Truax know where to get the surplus gear, he knows exactly how it can be used, because he worked at the heart of the missile and space program during the '50s and '60s. Among other achievements, he takes credit for originating the "Polaris" concept, for which he was awarded the Legion of Merit.

"This guy's been in rockets for 40 years and he's never had any serious accidents," says his longtime friend, Fred Durant III, special assistant to the director of

the National Air and Space Museum in Washington, D.C. "He's always been a garage mechanic in the rocket business, but I have high regard for Bob Truax."

For years, financing was often a hand-to-mouth proposition. But recently, Truax's dream has attracted the interest of Chicago real-estate man John Oelerich, 36. He put together a group of 38 investors to back the project, which, so far, has cost only \$150,000 to \$200,000.

\$1000-a-minute ride

"It is our plan to open the barnstorming era of space flight by selling rides into space to anyone having a yen to see our beautiful earth from out there," Truax says of the 10- to 15-minute ride. "We currently estimate the price of a ticket at less than \$10,000. A high price perhaps, but it would be the experience of a lifetime."

Although Knievel is no longer considered a potential astronaut aboard the X-3, there's no shortage of volunteers for the first manned flight. The problem is finding someone with minimal flight qualifications who's small enough to sit upright on a stool in the 25-inch-wide nose cone.

And will Capt. Truax take a ride himself? "Not me. I'm genetically chicken," he says.

Editor: Gurney Williams III

Contributors: Tony Assenza, Susan Bratt, Josh Eppinger, Hans Fantel, John Ingerson, Tom Johnson, Stacy V. Jones, Neil L. Shapiro, Gary Wittenburg



Pilots will ride in a tiny cockpit.

ELECTRONICS

Down to bass-ics

After years of trying to reach the upper limits of the audible range, speaker designers now seem to be going the other way. Suddenly, they are delving for the depths.

One reason for this turnabout is that the heights have been conquered. The latest tweeters have no trouble reaching all the way to the top, so attention now shifts.

Designers used to be quite complacent about response below 40 Hz. They figured that only rarely did musical notes fall below that pitch. But that's no longer so. The advent of digitally recorded master tapes (from which so-called digital records are produced) has made it easier to capture the bottom lows on record.

In response to this challenge, a number of companies are now producing subwoofers—special, low-frequency speakers that take over where "normal" speakers leave off.

It is not necessary to have separate left and right subwoofers for stereo. Rather, the bass from both stereo channels can be pooled in a single subwoofer. That's because the lower frequencies are inherently nondirectional, and in the bass range, the distinction between left and right is lost.

An extra subwoofer in the system particularly complements the newly popular minispeakers, which are inherently bass-shy. One subwoofer especially de-

signed as a bass extender for small speakers is the Ohm N2 for \$385. It's an unusually compact, almost cube-shaped box (15 × 15 × 16 inches), containing two 8-inch woofers which reach all the way down to 30 Hz. Unlike most subwoofers, the Ohm N2 is not greedy for power; 10 watts suffice for its needs. Yet it will handle up to 100 watts easily.

Instead of two full-range speakers, it is now possible to use so-called satellite speakers—small speakers handling only the upper range—and combine them with a subwoofer to handle the bottom.

The advantage is that the small satellites (left and right) can easily be put on shelves or hung on the wall—thereby saving floor space—while the subwoofer itself can be used as a coffee table (if you don't mind occasionally rattling your cups). Such an arrangement takes up less space than two conventional, full size speakers. Ohm also offers its subwoofer as part of such a complete three-part system, with their Model M minispeakers serving as satellites. The total system price is a hefty \$950, but the sound is splendid.

The most awesome bass to be heard from any of the new subwoofers comes from a contraption called the Contre-Bombarde, named after the deepest of all organ pipes. Produced by Shahinian Acoustics of Selden, N.Y., this massive (35 × 27 × 18 inch) unit aims not to save space, but to render the utmost lows of the audible spectrum down to 16 Hz. The horn-shaped, 20-foot-long sound path inside the box enables



It's not a Frisbee with racing stripes; it's a patented 12-inch computer disc with 100 times the capacity of most data storage systems. It can hold all the words that are found in a multivolume encyclopedia.

the Contre-Bombarde to emit ultradeep sounds. These are not so much heard through the ears as they are felt through vibrations of the body. When driven by a suitably powerful amplifier, this unique \$850 device moves the air enough to blow out matches.

One-watt travel news

Though the Travel Information Service is limited to transmitters of 1 watt and antennas under 10 feet, you'll be hearing more from it soon. Many car makers have expanded the tuning range on their AM radio dials to receive the service, and one—Chrysler—has been touting the change.

Right now, it's used mostly in national parks and airports to provide tourist information. Walt Disney World uses it to announce events at the "theme park" to drivers in the area.

But many, such as Charles Mathey, an analyst with the Futures Group in Hartford, Conn., foresee other uses. He predicts the tiny transmitters will send up-to-the-minute local weather forecasts and even information tailored to the interests of small neighborhoods, keeping drivers in touch with local events as they drive from block to block.



Ohm N2 subwoofer (left) has two 8-inch woofers which reach down to bone-thumping 30 Hz. Ohm minispeakers (right) handle the high notes in \$950 set.

WORKSHOP MINICOURSE

PORTABLE DRILL ACCESSORIES

If you're a regular reader of this column, you are probably aware that I am not a fan of the all-in-one type of tool. As a professional carpenter, I have learned that you profit when you buy the best of each type of tool that you can afford.

However, that doesn't mean that you should bypass sensible, and in some cases, ingenious accessories that are intended for use with various tools. Several good cases in point are the handy accessories that may be used with portable drills.

Since hole boring is a drill's primary function, a look at some of the accessories offered to ease that task will be worthwhile. Screw-Mate bits, offered by Stanley Tools, top the list. With one of these, you can drill thread and shank holes, while countersinking for the head, in one drilling step.

These handy bits are sized to suit both diameter and length of screws of various dimensions. Thus, if you are working with 1 1/4-in., No. 8 screws, for example, simply select the proper bit to suit that size. Over the course of several workshop or home-improvement jobs, you are

likely to accumulate all of the available sizes.

Several manufacturers offer a bit of this type that is adjustable. They are available at hardware stores and from retailers such as Sears and J.C. Penney.

You can also buy a version that goes one step beyond the countersink stage. It bores a counterbore to receive the screw-hiding dowels or dowel buttons.

Stop that drill

Often, it is extremely important that a bit bores just so far, and no more. For instance, when you are fastening two boards together—where both outside surfaces will show—you want to be sure that the bit stops before breaking through the far side. To prevent this from happening, you must use some sort of stop to alert you when the desired depth has been reached.

There are several good commercial drill stops that are available. One is shown in the photograph below. However, I have found that the masking-tape stunt, which costs almost nothing, usually does the job



A great timesaver when using screws is the Screw-Mate bit from Stanley Tools. In one operation, it makes holes for threads and shank and the countersink for the head. Several manufacturers now offer these bits, and some of them are adjustable.



Scrap block was bored with Screw-Mate, then halved on the table saw to illustrate how the bit does its job. Without this tool, you will need two different-size bits plus a countersink to bore the screw-head recess. That means three bit-change steps, as well as time-consuming three-step drilling.



In order to bore a hole to a predetermined depth, you must affix a stop of some sort to the bit doing the drilling. Here, a commercial version is set the desired distance from the bit's end. When it contacts the wood surface, hole is bored the correct depth.



Sections A and B are located on the bit. The last piece, C, is screwed onto threads of A to lock the stop where desired on bit.



The simplest stop of all—and the one that I use most often with my portable drill—is a strip of masking tape placed around bit in a flag-fashion, as shown. Bottom edge of tape signals desired depth. When it touches workpiece, stop drilling. Flag moves if pressed against surface, so check distance frequently with a ruler.

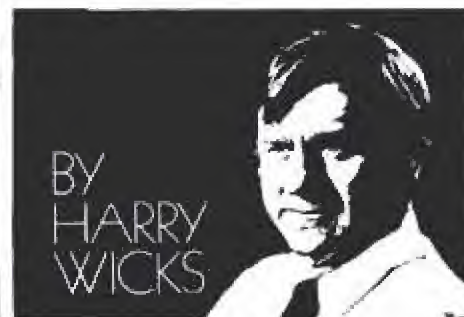


You can fashion a quickie stop by slipping a tight-fitting rubber washer over the bit. Note—this type moves under pressure.

as effectively as any of the commercial models. But when you're drilling a number of holes of the same depth, remember that the tape marker will travel up the bit slightly each time it hits the work surface. For this reason, you should frequently check the distance from the tape's lower edge to the bit point. If the tape has moved, replace it with a fresh strip of tape.

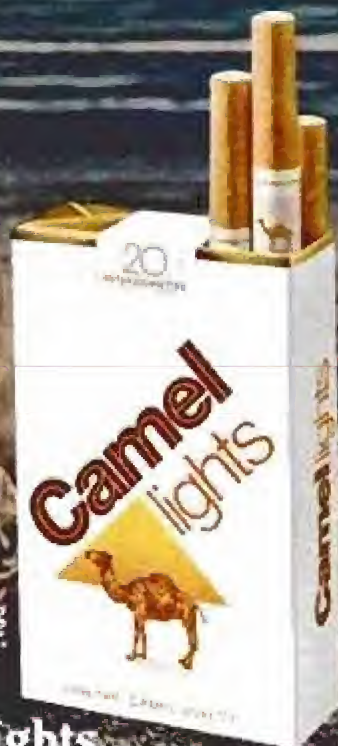
A word of caution: When you buy a drill accessory, take the time to read the manufacturer's instructions. If there are safety rules to be followed, they will be clearly delineated in the literature which accompanies the tool. And, you should heed the advice.

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HOME COMPUTER

(Continued from page 131)

bulletin boards. One, at the University of Iowa, attracts mostly doctors—anesthesiologists. A board in New Jersey is mainly for radio hams. Some boards feature free software for various computers. Pick up a few programs and the cost of the call becomes insignificant.

Ed Magnin, a home-grown entrepreneur, has extended the concept of the home computer bulletin board into the commercial arena. His company, the Telephone Software Connection (see source list, below) sells software for the Apple II computer. Anyone with an Apple and a charge card can call the Connection and order a program from an on-screen catalog. The program is sent over the phone and billed to the charge card. One program Ed sells is the actual telephone transfer program, so that friends can swap software over the phone. (It's a great program to use—we tried it.)

Magnin is the first person we know of to sell directly from his home via a personal computer. We suspect he will be the first in a long line of industrious computer-age merchants.

A computer in your future

As the home computer continues to be discovered by more and more hobbyists and businessmen, these small bulletin boards will proliferate. Already, there is some talk about hooking them into a voluntary network to rival the big fellows.

Soon, everyone—high schooler or graduate student—will have access to information comparable to the complete Library of Congress. Shoppers will choose items without leaving home. Conversations will be stored on floppy discs. Mail will always be instantaneous.

By the end of the decade, nearly every home will have access to some sort of computer network. **EM**

SOURCE LIST

For Micronet, write Compuserve Personal Computing Div., 5000 Arlington Center Blvd., Columbus, Ohio 43220 (\$9 hookup charge and \$5/hour).

For the Source, write Telecomputing Corp. of America, 1616 Anderson Rd., McLean, Va. 22102 (\$100 hookup, \$4.25/hour).

The following are for computer-to-computer calls only: The Telephone Software Connection (Apple II software for sale) (213) 329-3715.

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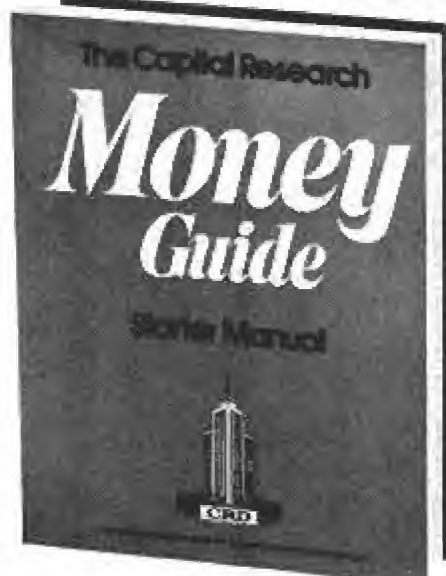
*ABBS indicates Apple Bulletin Board System.

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"Noodling" for opals in the spoil around the Coober Pedy mines. Opals are crystalline and they contain as much as 30 percent water—one tap can shatter a priceless gemstone.

size from a fraction of an ounce to a huge 150-ounce stone of surpassing beauty, discovered a few years ago (now part of the British crown jewels). Miners report finding opals worth approximately a total of \$25 million every year, but the actual figure is doubtless closer to twice that. This is because many miners are reluctant to admit how much they find for fear of taxes and robbery; and opal buyers are even more secretive.

A man can be living from a grubstake one day, digging in his shaft perhaps 60 feet beneath the surface of the ground with a pick or jackhammer, make one lucky strike, and discover he's rich.

A fortune in an hour

It all started in 1915, when J.R. Hutchison, a gold prospector, and his 14-year-old son Billy camped at the foot of the last escarpment of the Stuart Range. While his father searched for water, young Bill picked up a rare crystal opal, which blazed with colors in the late afternoon sunlight. He found another opal (called a "floater" since it was lying loose on the earth's surface), and then another. When his father returned, the boy already held a fortune in his hand.

When father and son emerged from the Outback with their story, the great opal rush was on. Miners hurried to the Outback from all over the world. Today, there are men and women in the field from 43 nations; many of them are refugees from eastern Europe. They savor the freedom of one of the world's few remaining frontiers, where people need not even own up to their own names. Miners are known through-

out the town by such monickers as Crocodile Harry, Big Nose Bill, Steve with Beard, Little Steve, Hungarian Steve, Italian Steve, Sue Long Legs and Ready Alice.

The washboard road

Even getting to Coober Pedy can be exciting. Most of the opal buyers are from Hong Kong, where the precious stones are cut and mounted. With satchels containing thousands in cash clutched tightly, they fly into town on Opal Air Lines' eight-passenger Cessna 421. They may encounter an Outback dust storm with 70-mph winds whipping clouds of dust as high as 15,000 feet, or discover that a rainstorm, as violent as it is rare, has turned the dirt landing strip into a quagmire. (At least there is now a landing strip. Until recently a plane had to touch down on the rutted surface of the Stuart Highway at the edge of town and taxi down the main street.)

The Stuart Highway, known as "The Track," is one of the world's most adventurous roads. It is the principal way to get to Coober Pedy. It runs north from coastal Adelaide, 375 miles to the south, through the opal fields on its way across Australia to the tropical north coast.

The bitumen pavement ends at Port Augusta, and from there on, the washboard corrugations are sometimes hubcap-deep. The holes, filled with powdery dust, can engulf a car up to the floorboards. Let a torrential rain hit The Track, and even four-wheel-drives become mired. Helicopters drop emergency rations to marooned travelers, and Coober Pedy begins to run short on everything. Despite its relatively small

Please turn to page 154

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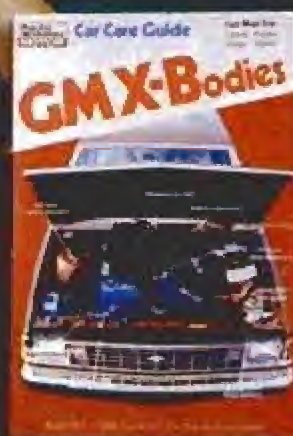
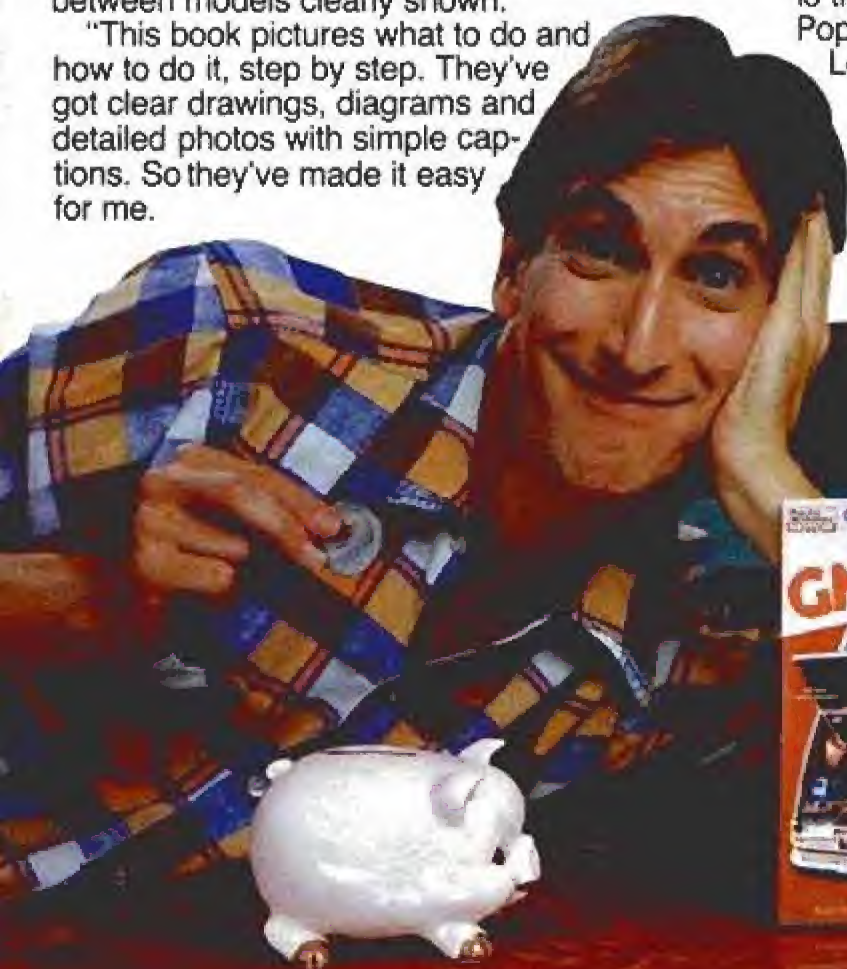
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sank a hole one meter in diameter in three days. The next year, the Proline drill put down three-meter-wide test holes in a day, and modified drills of this design are still in use. The Investigator Model Mark X, made at Adelaide, is the drill that's currently used for sinking test holes.

It has the ability to sink five test holes per hour to a depth of 60 to 70 feet. If it hits sandstone that might contain opals, it stops automatically.

Today, most of the material is brought to the surface pneumatically by giant blowers that toss it onto huge mounds. Down below ground, Bobcat loaders are used to gather the broken rock from the working face of the mine. It remained for Warwick Goldsworthy, a miner who discovered a fortune in opals and founded Opal Airlines, to develop an orbital tunneling machine, which cuts its way through rock at a furious pace. Today, there are 35 of these machines being used.

Where the overburden is shallow, some miners prefer to open-cut to reach the sandstone-bearing opal. They employ giant strip-mining bulldozers, valued at \$250,000 each.

Kids spot 'em faster

Picking the precious stones from the rubble remains a problem. A miner develops a fine eye for color, but it is acknowledged that children, who have sharp eyes, are better at it. In their after-school hours, most Coober Pedy kids go out to abandoned workings to "noodle" for spending money.

Because opals show up well in black light, some miners pull enormous portable light boxes into their dig-

Please turn to page 156

THE TOWN THAT WENT UNDERGROUND

(Continued from page 152)

size, Coober Pedy is so mechanized that only two Australian cities consume larger amounts of diesel fuel and gasoline.

You can dig anywhere

The law allows each miner to stake out a claim of 50 yards by 50 yards on any government land to prospect for opals. He pays \$10 for an annual "miner's right," and he's ready to become a two-legged ant digging for riches. Since opals were formed, at random, 30 million years ago by ground water charged with silica evaporating through clay, there is no strict pattern of distribution. The best trained geologists are of little use in choosing a mining site.

A veteran miner will toss his hat over his shoulder and begin to dig wherever it lands. He parks a 240-volt generator to power his electric lights, and an air compressor to power his jackhammer at the top of his mine shaft. He climbs down his steel ladder, perhaps 50 feet into the ground, and drives a horizontal tunnel into the sandstone rock.

For blasting, he uses gelignite, instead of dynamite, because it is less likely to shatter the opals. He chops out chunks of gray, translucent "potch" with a hand pick, keeping a keen eye on it for the flash of color that indicates an opal. If he suspects he has found an opal, he licks the stone to bring out the color. Once he's positively identified an opal, he uses a penknife to painstakingly remove it. This requires a surgeon's precision, since opals are crystalline, containing as much as 30 percent water, and shatter with just a tap.

Calweld drills, first used at Coober Pedy in 1963,

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HINTS FROM READERS

Compost sifter



There's no need to put off using compost until all matter has decomposed entirely. Make a sifter of 1/2-in.-mesh hardware cloth attached to a wood frame. Use it to sift out the compost that's ready for use.—David W. Roberts

Handles from electric irons



This tool provides a nonskid grip for handling stock on a table saw. Use epoxy to cement rubber matting topped by a wood base to the iron handle.



A board with an end stop and an iron handle cemented on it is a good aid for pushing work through a jointer.

Save the plastic handles from electric irons that must be discarded. The handles are designed with comfortable grips. You can use them on shop tools.—Edward P. Groh and Charles R. Cohn



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TOWN THAT WENT UNDERGROUND

(Continued from page 154)

gings. Their interiors are illuminated by black light so that, as the potch goes dancing past on a conveyor, the opals will flash out of the gloom.

With so much ready wealth lying around, it follows that crime is not unknown. Thieves sometimes sneak into the mines at night and steal the stones right off the walls. Miners usually keep a rifle handy.

One night, robbers entered the room of Farid Khan, a buyer staying at the Opal Inn, and slit his throat as he slept. Bleeding and gasping, he managed to fight his way free, and the thieves fled without either his opals or his cash. The Royal Flying Doctor came from Port Augusta and saved his life. Khan, undeterred by the incident, is still buying opals in Coober Pedy.

Six days in a shaft

Actually, there is less violent crime in Coober Pedy than its reputation suggests, but there are frequent brawls. Most serious injuries are mining accidents. One old-timer tumbled down a mine shaft and was too weak to cry out. He kept saliva in his mouth by chewing on the brim of his hat. Blowflies deposited their eggs in his wounded left hand, and he had to observe the maggots hatching and feeding on his flesh.

For six days and nights he lay there, until a friend discovered him. The rescue party tied him to a chair and hoisted him to the surface. That old-timer was a real Outback man—he lived.

Mining in the winter is a reasonably comfortable matter, but as December brings summer, heat begins to mount with furious intensity. By Christmas, a man gets up at 3:00 a.m. and works until 10 in the morning, which is the coolest part of the day. He goes to his home, preferably underground, showers and lunches, and then takes a long afternoon siesta. In the evening, the pubs, pizza places and various clubs devoted to the social life of the Italians, Serbs, Greeks, Ukrainians, Croats, Slovenians and others come to life. The church, a restaurant, shops and a motel are all underground.

A typical residential dugout usually has such amenities as wall-to-wall carpeting, stereo, a modern kitchen, running water, electric lighting, even a swimming pool.

Warwick Goldsworthy used his tunneling machine to dig out a hill. He put two horizontal cuts into the hillside to provide a 90-foot-long hall. Then he cut nine big rooms off the hall. His 15-by-30-foot kitchen

features a portable gas stove, stainless-steel sink with running water and a kerosene refrigerator.

It is possible to locate a miner's dwelling from the surface from the fresh-air vents which stick up out of the ground. Often there is a small windmill at the surface, which spins in the almost constant Outback wind. This turns a generator, which supplies 30-volt electricity that is stored in large underground batteries. There is also a water storage tank situated on the surface to capture any runoff from infrequent rainstorms.

Doug the Waterman hauls water to the miners' tanks from the bore well, which reaches 300 feet deep to ground water. The water is undrinkable until it is put through solar stills resembling small glass houses.

This water is then put through a reverse osmosis process to further separate the undesirable minerals. This provides Coober Pedy with 24,000 gallons of water a day.

Energy-saving lessons

Living down under in Down Under Australia has become an extraordinary way of life, which, in this energy-conscious time, has much to teach people in more favored climates. A dugout requires no heat in winter and no cooling in summer since it takes its constant temperature from the surrounding sandstone. There are no flies, such as gather in clouds around people at the surface of the Outback, crawling into ears and eyes. There is no dust—and there's a deep quiet.

A miner can throw a wild party lasting half the night, and the family in the dugout next door will never hear it. If a dugout owner decides to take a jackhammer or a tunneling machine and add an additional bathroom or a family room, he is apt to dig enough opals out of the excavated area to more than pay for furnishing the addition. One miner drilled a new toilet vent for his dugout and found a \$27,000 opal.

With walls about 15 feet thick, Coober Pedy dugouts are rock-strong. Miner Eric Smith, who lives on the edge of town, says that his west wall is "1200 miles thick" since it stretches from Coober Pedy to the Indian Ocean. The sandstone impregnated with silica is so strong that ceilings can arch over large rooms with complete safety.

"When you climb into your bed and click off the light," one miner says, "you find it pitch black. It is completely silent and peaceful. At first, it's a little eerie, but once you're used to it, you sleep as content as a baby in mother Earth's womb." **PM**

5 great shop ideas from clever craftsmen

Lathe toolpost steady rest

This steady rest is particularly useful when drilling center holes in slender rods that extend far from the headstock chuck. By pressing against the rod near its free end, the tool discourages wobbling. A combination center drill and countersink bit is used in the tailstock chuck to form the center hole. The steady rest is clamped in the toolpost with a washer, but without the customary rocker.

The tool has only six parts: two 8-32 bolts and washers, a steel plate with a 90° notch in one edge, and a shank to which the plate is bolted.

Make the steady rest by first clamping the shank (B) in the lathe toolpost. Clamp the plate (A) to the shank with its lower edge aligned to the lower shank edge. Bring the plate against the point of the tailstock center, and mark the point on the plate. Then cut the notch, using the point as its apex. As the rest is used to steady slender workpieces, cut the notch $\frac{1}{2}$ to $\frac{3}{8}$ in. deep.

Use a No. 29 twist drill to "rough-in" the holes for the two 8-32 bolts. Drill the plate holes first, centering about $\frac{1}{16}$ in. from each edge. Align the lower edges and clamp the plate against the shank so the lower notch edge is about $\frac{1}{16}$ in. beyond the angled shank end. The plate serves as a template for drilling the holes in the shank. Enlarge the holes to the bolt body size (a No. 18 drill bit was used for the plate shown) and thread the holes in the shank with an 8-32 tap.

To provide for fine adjustment of the notch position, elongate the holes vertically in the plate $\frac{1}{32}$ in. each way. This permits the plate to be shifted up or down with respect to the workpiece. The third $\frac{1}{4}$ -in. hole shown in the plate is optional. It's useful for hanging the tool on a nail.

To use the steady rest, clamp it firmly in the toolpost. Loosen the plate screws, and position the carriage so both notch edges of the plate can be brought to bear against the tailstock spindle. Tighten the bolts. The notch is now centered with respect to the lathe centerline, and a rod pressing against it should have its center aligned with a drill bit in a tailstock chuck.

If the rod is not straight when drilling the center hole, the hole will be slightly oversized. Using a sharp bit, continue drilling until the countersink part of the bit has formed a conical opening of the desired depth. The center hole will then be larger than the bit would normally make, but it will be centered with respect to the rod's circumference.

You can spot polish the tool by using an ink eraser in a drill-press.

—Walter E. Burton



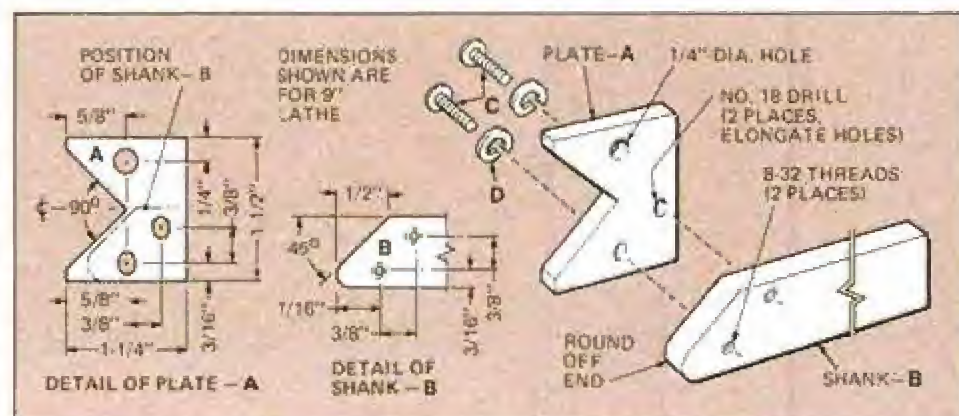
With steady rest clamped in lathe toolpost, a drop of oil is applied where the notched plate presses workpiece.

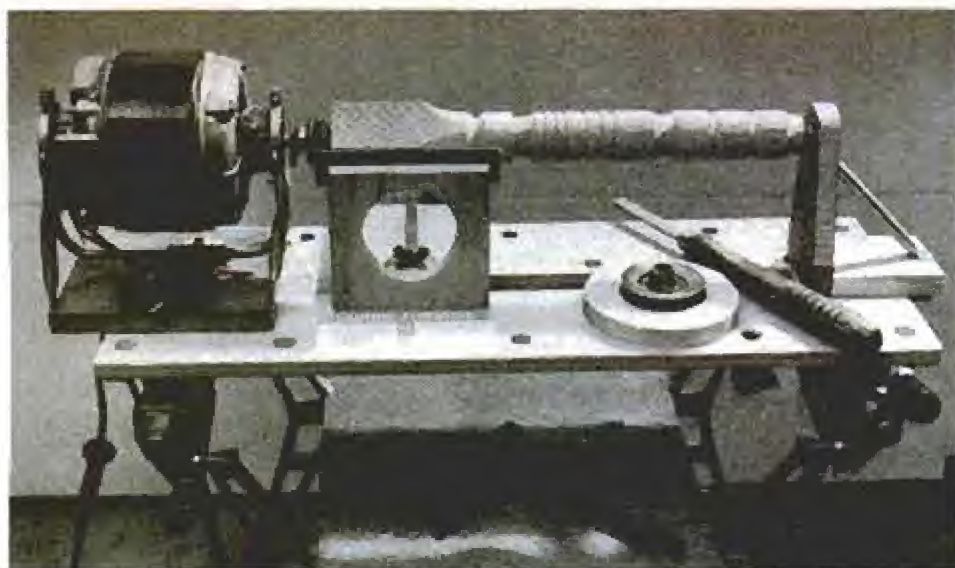


To center the notch with respect to the lathe centerline, position the carriage so plate can be brought to bear against tailstock spindle. Third hole is optional.

MATERIALS LIST—STEADY REST

Key	No.	Size and description (use)
A	1	$\frac{3}{16} \times 1\frac{1}{4} \times 1\frac{1}{2}$ " steel (plate)
B	1	$\frac{3}{8} \times \frac{3}{4} \times 3\frac{3}{4}$ " steel (shank)
C	2	8-32 $\times \frac{1}{2}$ " machine screws
D	2	8-32 split-ring lock washers





The Workmate table made by Black & Decker serves as a bed for this shop-built lathe.

Homemade lathe from washing-machine motor

Before investing a lot of money in a lathe, consider making this shop-built version. Powered by a motor from a retired washing machine, the lathe "bed" is the familiar Workmate from Black & Decker.

If you don't have a motor on hand, you can buy one for about \$5 to \$10 from an appliance repair shop. Most are rated at 1725 rpm, which will do the job, but a motor rated at 3450 rpm will do it better. Don't worry if the starter is burned out—that allows you to reverse the motor by hand-starting it in either direction. You will have to remount the motor on a wooden platform to which a cleat is attached to accommodate the Workmate jaws.

To construct a headstock spindle, tap a 10-32 stud into the end of the motor shaft. File the stud to a point with the motor running, after the toolpost has been built. Wearing safety glasses, use the file in combination with the toolpost. Next, drill and tap four 10-32 studs into a collar and file each to a chisel point extending about 1/4 in. from the face.

After the motor is clamped in the Workmate jaws, build the tailstock as shown. Mark the location for the dead-center hole by placing the tailstock face against the headstock spindle point.

The toolpost is made from three pieces of 3/4-in. plywood or pine stock. The space between the base pieces holds the carriage bolt and wingnut. You can place the toolpost in any position and you can also turn a faceplate on this lathe.

See that the motor is properly grounded before operation. As the tailstock has no threaded adjust-

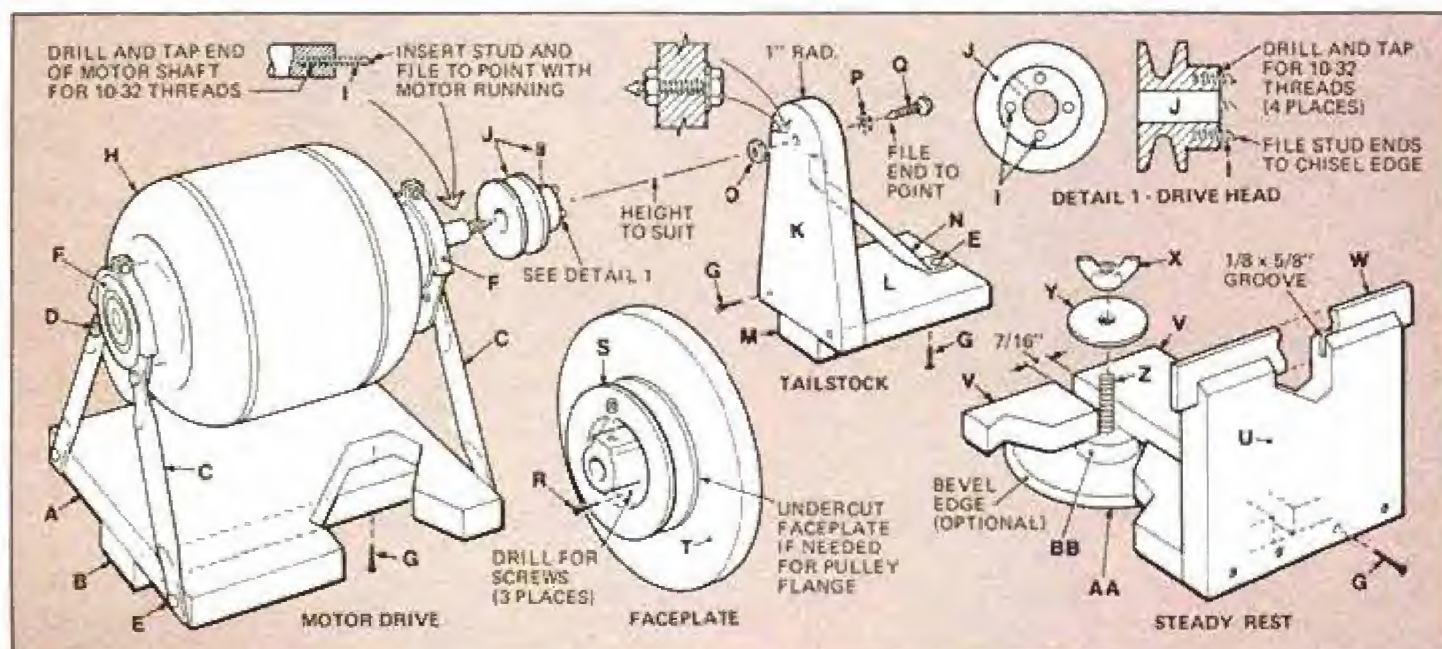


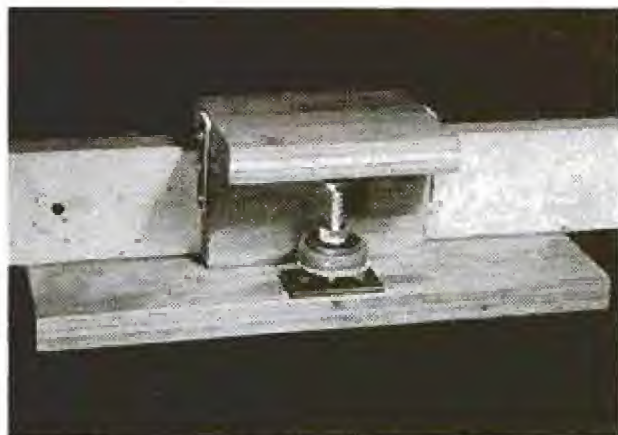
Using a pulley wheel as a mount, low-cost lathe can be used for faceplate turning.

ment, clamp the work between the centers by tapping the back of the tailstock. To remove, tap away from the workpiece.—F. H. Loudon

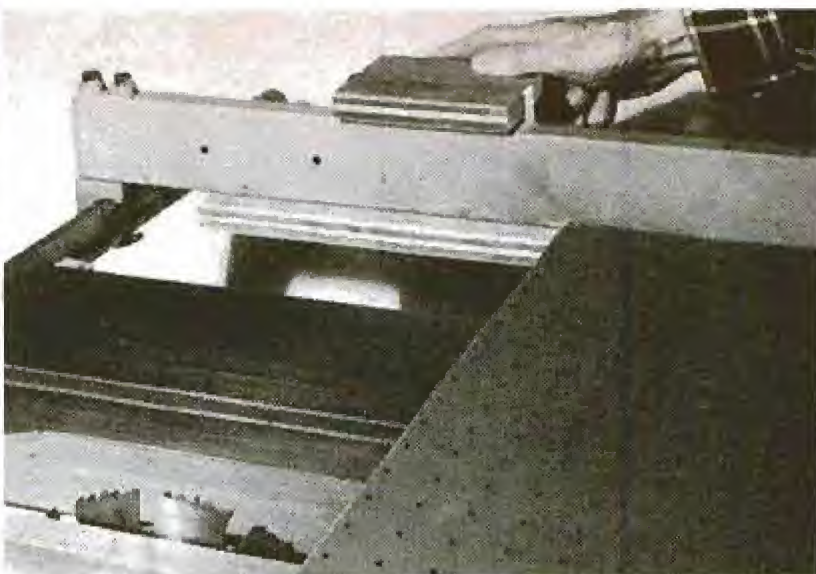
MATERIALS LIST—LATHE

Key	No.	Size and description (uses)
A	1	3/4 x 7 1/2 x 7 1/2" plywood
B	1	3/4 x 1 1/2 x 7 1/2" plywood (cleat)
C	4	1/2" aluminum tubing
D	4	10-32 x 1/2" machine screws
E	6	3/4 No. 8 rh screws
F	2	rubber motor mount (1/2" shaft)
G	10	No. 10 rh screws
H	1	washing machine motor
I	5	10-32 x 1" studs
J	1	2"-dia. pulley with collar and setscrew
K	1	3/4" plywood (tailstock face)
L	1	3/4 x 3 1/2 x 4 1/4" (tailstock platform)
M	1	3/4 x 1 1/2 x 5" plywood (cleat)
N	1	1/2" aluminum tubing (strut or handle)
O	1	1/4-20 hex nut
P	1	external tooth washer
Q	1	1/4-20 x 1 1/2" hexagonal bolt
R	3	1" No. 8 rh screw
S	1	3"-dia. pulley with setscrew
T	1	3/4 x 5 1/4"-dia. plywood or stock
U	1	3/4 x 5 1/4 x 5 1/4" steady-rest face
V	2	3/4 x 2 1/2 x 7 1/2" steady-rest platform
W	1	1/2 x 1 1/4 x 6 1/2" steel plate (rest)
X	1	3/8" wingnut
Y	1	7/8-ld. x 1 1/4" o.d. washer
Z	1	3/4 x 3 1/4" carriage bolt
AA	1	1/4 x 5"-dia. retainer
BB	1	3/4 x 1 7/8"-dia. spacer lug





Locking bolt is provided with a 1½-in.-dia. knob so you can turn it easily with your fingers. This knob was made by sandwiching a metal jar cap between two large washers and hex nuts. The locking bolt has to be positioned in its hole before tilting block is installed.



Circular saw panel rest

When cutting a wide, thin panel on a circular saw, the panel edge has a tendency to slip beneath a fence positioned on guide bars. This can cause jamming and/or kick-back. At the least, it can ruin the cut and material.

The panel-support attachment

shown in the photos above was designed to keep the panel edge moving smoothly along, without slipping under the rip fence. The attachment can be installed in seconds, and it removes just as fast.

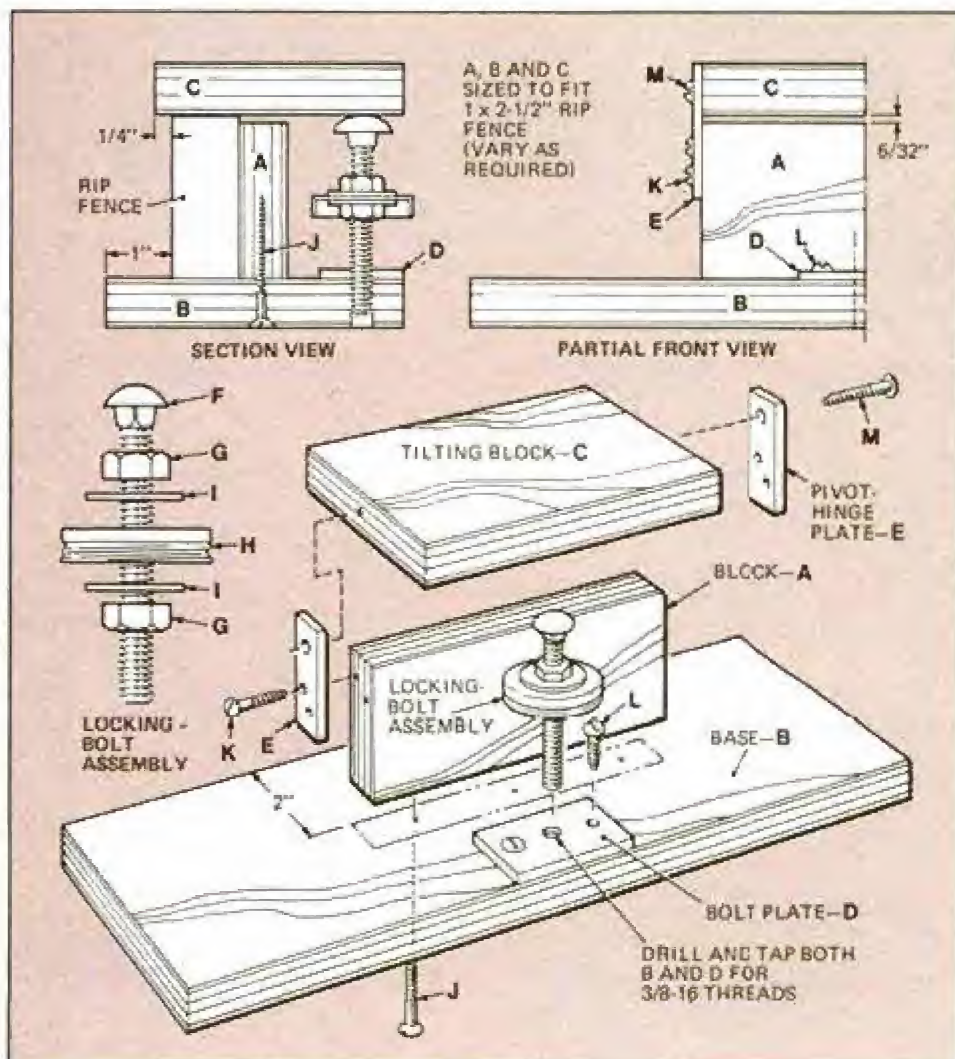
Fir plywood ¾ in. thick is used for the three wooden parts of the attachment. The screw that provides clamping pressure is a ¾-in.×16 carriage bolt 3 in. long. It operates through a threaded hole in a ½-in.-thick steel plate fastened to

the base. A ¼-in. hole is drilled in the center of this plate after the plate is mounted in position on the base. Then both the plate and wood are threaded.

The vertical piece (A) is attached to the base (B) with three 2-in., No. 6 flathead wood screws. The two pivot-hinge plates joining pieces C and A are made from the same ½-in. steel as the threaded bolt plate. Each plate is fastened to (A) with 1-in., No. 6, roundhead screws. The pivot-hinge pins extending into the pivoted piece (C) are 1½-in., No. 8 roundhead screws.

Positioning the pivot-hinge plates is the most critical operation in assembling the panel support attachment. For ease of attachment and removal, it's best to make the clearance between parts B and C slightly greater than the height of the rip fence. After the hinge plates are attached to block (A), the assembly of A and B is fastened with a C-clamp to the rip fence. A piece of thin cardboard is placed on top of the rip fence and assembly. Then, the tilting block is placed on top of the cardboard, projecting about ¼ in. beyond the inner edge of the rip fence. Now, align the hinge plates with part C and mark the plate holes carefully. Drill pilot holes and install the screws. Remove the cardboard and test the panel support for fit.

The "lockbolt knob" is a metal jar cap fitted between two large washers and hex nuts.—C.E. Banister

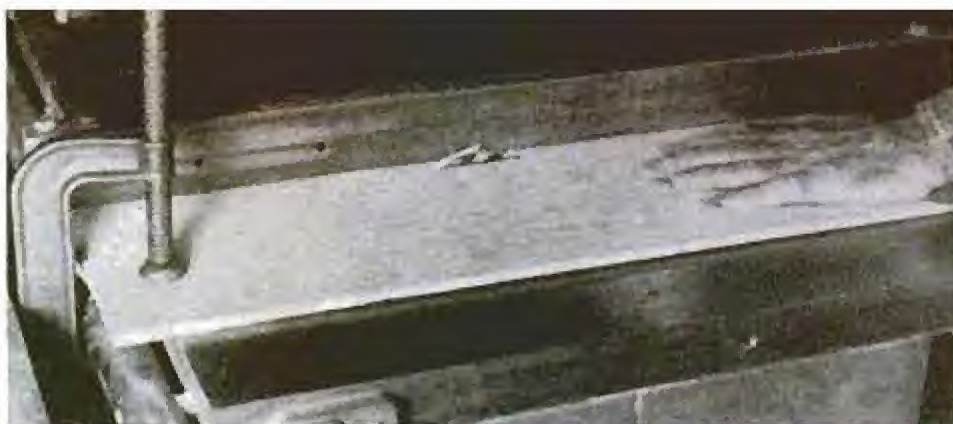


MATERIAL LIST—PANEL SUPPORT

Key	No.	Size and description (use)
A	1	¾×2½×5" plywood (block)
B	1	¾×4½×12" plywood (base)
C	1	¾×4½×5" plywood (tilting block)
D	1	½×1½×2" steel (bolt plate)
E	2	½×¾×2" pivot hinge (steel plate)
F	1	3/8-16×3" carriage bolt
G	2	3/8-16 hex nut
H	1	1½"-dia. jar top
I	2	1½"-dia. washer
J	3	2" No. 6 rh screws
K	4	1" No. 6 rh screws
L	2	¾" No. 6 rh screws
M	2	1½" No. 8 rh screws

A simple circular saw accessory tool

A simple accessory table can eliminate the hazards of grooving short stock. The add-on is also good when grooving any length of stock with a width equal to or less than the saw opening in the table insert. The idea prevents the possibility of gouging at either end because the stock is fully supported throughout the entire cut. If grooving a narrow board, use a push stick. To prepare the board, first lower the blade below the table surface. Clamp a piece of $\frac{1}{4}$ -in. plywood to the table, with one edge butted against the fence as shown. Turn on the saw, and slowly crank the blade to a height $\frac{1}{8}$ in. higher than thickness of the stock to be cut. Then lower the blade to position for cut.—C. E. Banister



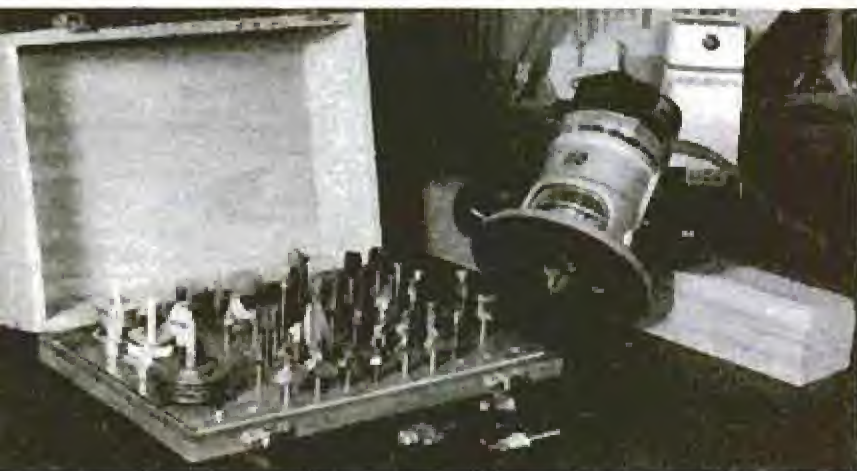
Clamp board securely to table, then elevate saw blade a bit beyond desired height.



Now, stock fed into blade is supported on both sides of blade by accessory tool.



Stock at end of cut is prevented from "dipping" into saw-blade hole by use of tool.

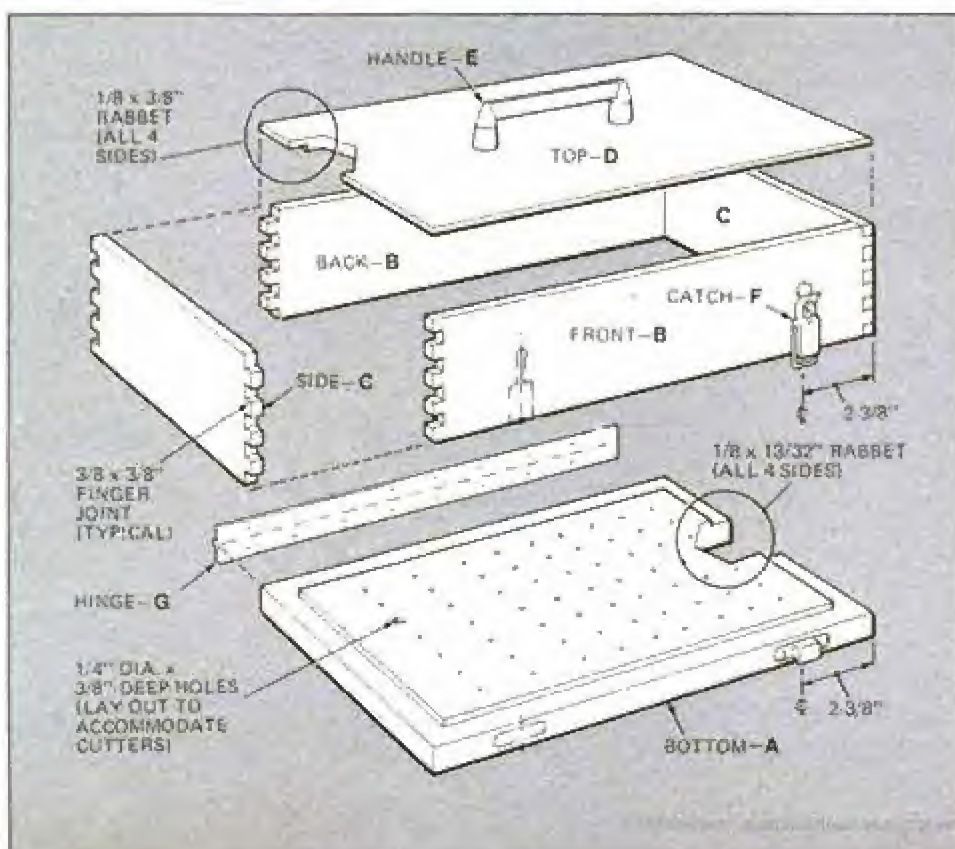


Finished box has luggage latches and drawer pull for a handle. The cover frame is red oak, and the top is $\frac{1}{4}$ -in. plywood. Photograph shows a base of $\frac{1}{4}$ -in. alder.

Router bit box

This worthwhile weekend project will save time when searching for the right router bit.

First, lay out your collection of bits to determine the size of the box you need. Cut to size, lay out the grid as shown in the drawing. Drill, shape and rabbet the edges of the base. Cut the finger joints about $\frac{1}{32}$ in. deeper than indicated so they can be sanded flush with the surface after assembly. To allow for this, add $\frac{1}{16}$ in. to both ends and sides when cutting to length. Cut top oversize to allow for sanding. Assemble box with glue and clamp overnight. Attach the $1\frac{1}{2}$ x 13-in. hinge to the base and top with No. 4 x $\frac{1}{2}$ -in. flat-head screws. Clamping the two sections together first helps this operation. Next, apply polyurethane varnish. After the box is completely dry, affix luggage catches (Brainerd No. 01867).—C. E. Banister



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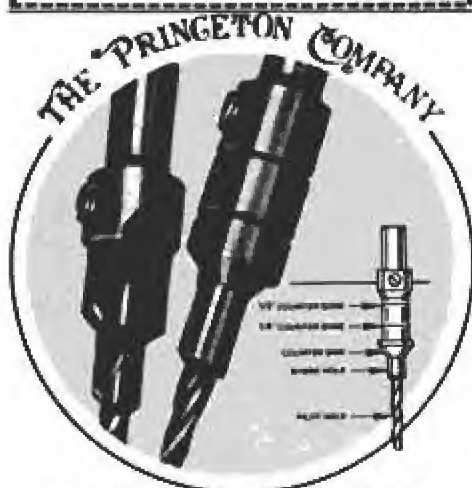
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DRIVING THE FORD EXP

(Continued from page 120)

have found it's quite easy and fairly cheap to incorporate IRS even on small economy cars.

The EXP and LN7 share the same MacPherson-strut front suspension and swing-arm rear suspension that the Escort and Lynx cars introduced last year. But there are significant differences which seem to make the system work better on these two new cars.

First of all, the EXP/LN7 are lighter and lower than the Escort/Lynx, giving them a lower center of gravity. This lower profile also reduces body lean considerably. Unlike the Escort, which sometimes gives you the impression it's about to scrape its door handles in hard cornering, the EXP goes around quite flat.

If you go for the optional TRX suspension package, you'll get an even better-handling car. The TRX comes with fatter stabilizer bars, stiffer shocks and springs and harder suspension-bushing material. This package adds significantly to road feel and cornering ability. Also included in the TRX package are styled aluminum wheels, similar to the ones found on the Porsche 928.

The power train

The only available engine for the EXP/LN7 cars is Ford's all-new 1.6-liter (97.6-cu.-in.) in-line Four. It produces 70 hp at 5200 rpm and 88 foot-pounds of torque at 3000 rpm. This engine certainly seems willing enough to please, but it's hampered by a wide-ratio manual gearbox. This is the same problem encountered in the Escort/Lynx.

The gear spacing—3.58, 2.05, 1.21 and .81, first through fourth, respectively—is too wide for the engine's narrow power band. Essentially, you have a three-speed gearbox with an overdrive fourth gear. This makes for a very economical engine, but one that lacks performance. The rpm drop between upshifts brings the engine below its power band. To maintain rapid acceleration means taking each gear up to redline. Ford confirms that a five-speed box with closer ratios and an overdrive fifth gear is in the works, but won't be available for at least two years.

On the positive side, the gearbox shifts well, with none of the vague, rubbery feel found in most front-wheel-drive transaxles.

The automatic gearbox doesn't seem to suffer as much as the manual even though it, too, is a wide-ratio unit. It doesn't hunt for gears, even going up a hill at moderate

speeds. It also has an overdrive top gear.

In all fairness, the gear-spacing problem probably won't even be noticed by most drivers. In real-world driving, it doesn't really matter. The problem only becomes annoying on a racetrack.

Sporty interior

Like the power train and suspension, the interior of the EXP/LN7 is borrowed from the Escort/Lynx, with some exceptions. The steering wheel is the same size, but the four-spoke hub is styled to look like a racing-type wheel. The seats are also constructed along more sporty lines and provide good lateral support.

The trim, finish and overall workmanship were quite good, even excellent, if you consider that the cars we drove were prototypes—virtually hand-built from preproduction bits. Even though the cars had been thrashed about quite a bit by groups of other journalists for two weeks prior to our testing, there weren't any creaky panels or droning resonances indicative of loose-fitting components.

The cabin of the two-seater version provides lots of room for two full-grown adults and lots of luggage space in the back. If you opt for the 2+2, you get the identical head- and legroom that you would in the two-seater, plus room in the back for two more people. But the rear-seat passengers wouldn't find it comfortable for more than a short ride.

Ford's feeling is that if you want room for four or five passengers, buy an Escort or a Granada. The whole marketing philosophy behind this car is rather like that of a European GT machine—a personal-transportation vehicle for two, with a shotgun seat for emergency transport of a third. In fact, EXP stands for Erika Project Personal car (Project cars are designated X).

Choice of options sufficient

The options list isn't excessively long, but it's quite enough to allow you to tailor the car to your liking. The list includes airconditioning, power steering, cruise control, the TRX package, optional rear seats, flip-up sunroof, luggage rack, AM/FM cassette player and lamb's-wool seat trim with leather bolsters (for the front seats only).

EPA mileage numbers aren't yet available, but from our experience with the Escort/Lynx, we'd peg it at over 30 mpg on the highway and about 23 mpg in the city. Price is also not yet set, but marketing types at Ford tell us it will be somewhere between \$7000 and \$9000.

FM

especially equipped to recover, there is only one thing to do: Bail out.

A handful of people have ridden such spins to the ground and survived. There is the story, for instance of Fred Patterson, who operated a small aircraft dealership at Peachtree Airport in Atlanta. On May 10, 1952, he was giving a demonstration ride in a Mooney Model 20C to three prospective buyers. They were all large men—so big, in fact, that the low-wing, single-engine monoplane was loaded to within 12 pounds of its maximum gross weight, with its center of gravity near the aft limit.

At around 10,000 feet, one of the prospective buyers asked, "What does it stall at?" Patterson told him.

"Well, let's see one," Patterson did one.

Then one of the others said, "Let's see another one."

This time, as the plane stalled, nose high, power off, the right wing suddenly dropped straight down and the airplane seemed to cartwheel. Almost immediately, the spin went flat.

The passengers began "whoopin' and a-hollerin'," recalls Patterson, "but I don't remember anything they said. I was too busy. One of them just about went crazy and was in tears the whole damn time."

Meantime, Patterson aggressively tried all the spin recovery techniques he had ever heard of. Nothing worked. "The elevators and the rudder felt like they weren't even there," he recalls. "They had absolutely no feel. Never did get the engine started. The prop's sitting there straight up and all you hear is a little air whistling."

Running out of options

"I tried lowering my landing gear and putting my flaps down. We tried opening the door. The door just stayed open—no wind came by. We tried to move as far forward as we could, but there was no way to halt the spin. Everybody in there weighed over 200 pounds."

The airplane, spinning flat, descended at about 1000 feet per minute. After about eight minutes, the top of a large pine tree lanced the aircraft where the left wing met the fuselage.

The airplane seemed to corkscrew down the trunk and "just ate every damn limb off that thing all the way to the ground." All four survived. The tree limbs had probably saved their lives.

Researchers may not know all the answers about spins, but they agree on one principle: One solution to the flat spin is to prevent spins from starting.

The effort to unravel the spins problem is proceeding today on several fronts:

■ NASA is improving on-board hardware carried by test planes so that pilots who purposefully enter spins are assured they'll get out of them alive.

■ The NASA tests have suggested some simple design modifications that may be incorporated into light planes to make them more spin-resistant.

■ Debate continues over whether general aviation pilots should be required to have spin training before getting a license. The Navy has begun additional flight training in handling the most difficult spins.

Peril of flopping chutes

Since some airplane spins are unrecoverable, one of NASA's first steps before starting full-scale tests was to develop a reliable way to recover from spins. Although spin-recovery parachutes had been used by test pilots for many years, the design, testing and in-flight use of these systems had not been thoroughly documented.

Manufacturers had lost some test airplanes because the parachute suspension lines were too long. The airplane could continue spinning without the chute exerting any restraining lateral force. Other planes went down because the lines were too short. The canopy just flopped around in the disturbed air behind the tail. That happened during one hairy ride by famed test pilot Bob Hoover (see illustrations beginning on page 109).

As he climbed an F-100A fighter to test altitude just south of Edwards Air Force Base in California that day in 1954, Hoover felt somewhat apprehensive.

"It was one of those grit-your-teeth types of flight-test programs," he recalls. "We knew from the wind-tunnel work that there was a good likelihood of the airplane going into a flat spin, and that if it did, you might have difficulty recovering."

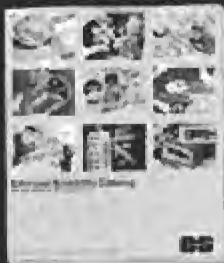
For some days before the flight, Hoover discussed recovery techniques with other North American pilots and engineers. The best bet for recovery, they decided, was to push the stick in the direction of the roll, and use opposite rudder.

At 42,000 feet, Hoover called the

(Please turn to page 166)

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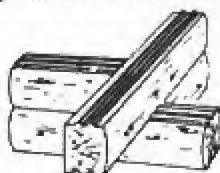


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HOW NASA IS UNWINDING DEADLY SPINS (Continued from page 165)

North American engineers in the Edwards tower on their company frequency and reported his position, heading and altitude. He reduced power and raised the nose. The aircraft lost speed, and as it reached the stall, he kicked full right rudder and applied left stick. The crossed controls caused the plane to "depart to the right" and whip into a spin. Then the nose came up.

Spin goes flat

"It's gone flat on me," he told the engineers in the tower. "I'm holding it for three turns."

After three turns, he reported "recovery controls" and that he was holding them for four turns. "No effect," he said.

The aircraft, nearly flat, was spinning rapidly. It seemed to be sliding sideways about its spin axis. At the same time, Hoover felt as though the plane were backing up. He tried each of the techniques they had discussed. Nothing worked.

He chopped the throttle to reduce the gyroscopic effect of the rotating engine and continued to work at recovery. He'd lost more than half his altitude by now, so he released his drag chute. It came out all right, but just flopped around behind the tail. The parachute lines were too short.

Hoover counted 22 turns from 42,000 feet down to about 15,000, where he jettisoned the cockpit canopy. He hoped that might upset the gyroscopic and inertial effects. It didn't. Strangely, with the canopy gone, there was no wind in the cockpit at all. All forward motion had ceased. The plane was descending vertically.

At about 7,000 feet above the desert, he tried to reach the ejection handle with his right hand, but he couldn't because of the centrifugal force. Finally, Hoover ejected with his left hand and, because he was being forced to the left side of the cockpit, he banged his arm as he went out.

"It was like coming out on the ground," said Hoover. "No wind at all."

Dropping faster than the plane

He tumbled over and over in free fall until the opening chute jerked him upright and his seat fell free. As he swung in his chute, out of the plane at last, he looked up. His airplane was pointed directly at him.

"During the free fall, I was falling much faster than the F-100, so I'd gone way below it. Although it was spinning at over a turn per second,

the sink rate wasn't very high. It was absolutely flat... I was staring at the airplane head-on for only a microsecond, and then it spun right around me. I watched it continue spinning until it hit the ground."

NASA researchers have taken pains to insure that their current spin-recovery chute would not malfunction like Hoover's.

As an initial precaution, they tested a variety of canopy diameters and line lengths on a dynamically scaled model in a Langley Research Center spin tunnel. Next, they designed a deployment method that uses a gun to fire a slug that pulls the pilot parachute and bridle line out to its full length, well clear of the airplane. The pilot chute, in turn, extracts the main canopy. And finally, they designed an attachment system that allows the chute to drop away harmlessly if it is accidentally deployed before the pilot "arms" the system by pulling a lever. Thorough testing on the ground and in the air proved that the gear would work reliably in an actual spin-recovery situation.

To date, NASA's Jim Patton has used the system 17 times to recover an airplane from otherwise unrecoverable spins.

As the NASA stall/spin program moved on to aircraft other than the much-spun Yankee, other means of spin recovery and pilot escape were adopted. A Beech Sundowner, for instance, is equipped with hydrogen peroxide-fueled spin-recovery rockets on the wing tips. Left and right control buttons on the pilot's control wheel select and fire the rockets to back up the rudder.

Blasting an emergency exit

Another safety feature for spin pilots is a device which blasts a 30-by-30-inch emergency opening in an aircraft's structure.

This was designed by NASA engineer Laurence Bement in response to a problem: A prototype Piper T-tail, scheduled for spin tests, has no door on the left side. So a test pilot might be unable to bail out, particularly in an unrecoverable right spin. Bement's solution is an explosive charge that cuts out a precise opening in the plane without harming the pilot who is sitting just a few inches away.

To activate the system, the pilot pulls a handle that cocks and releases a firing pin. A flexible, linear-shaped charge outlines the emergency-exit area. The exploding charge cleanly severs the skin and a

(Please turn to page 168)

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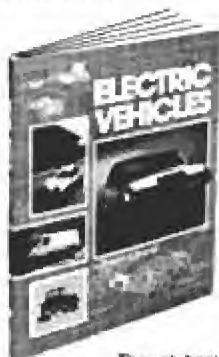
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HOW NASA IS UNWINDING DEADLY SPINS (Continued from page 166)

structural stringer, and propels the severed panel away from the airplane at approximately 45 feet per second.

Drooped wing and other designs

All of this safety gear has made it easier for NASA to get on with its mission, which is focused on airplane design technology. The basic question to be answered is, "What features help general aviation planes resist stall and spin?"

One promising answer is an odd-looking drooped wing. The outermost portion of the wing is angled forward with a distinct notch separating the lowered portion from the rest of the wing. NASA engineers say that the droop and notch act as an aerodynamic barrier. This prevents the stall—which starts near the fuselage and "walks" outward—from progressing over the full wing. A minor disadvantage: Performance is degraded by about one mile per hour at cruising speed.

Installation of a vertical fin under the fuselage—a ventral fin—also counters spin, the researchers have found, by damping the rate of rotation. And NASA is experimenting with sensitive systems, piggybacked onto flight control systems, that automatically take over and prevent spins. Basically, this hardware keeps track of the angle of attack, and it cross-connects controls to keep planes out of stalls.

'Goose' won't stall

Another intriguing design now being tested at Langley is the canard, so called because it looks like a goose in flight. The main wing is mounted at the tail of the aircraft, with a much smaller load-carrying wing at the nose. Because the forward wing is mounted at a slightly higher angle than the main wing, it always stalls first. When this occurs, the nose drops, preventing the main wing from ever reaching a stalled condition.

It's too early to say which of these design details will show up on future general aviation aircraft. But NASA has kept in close contact with manufacturers who have shown keen interest. So there's a good chance that at least some of these spin-resisting features may begin showing up on light planes in the mid-1980s.

To train or not to train

NASA's work is aimed at lessening the danger of spins by improving designs. But until all planes are spinproof, pilots will continue to car-

ry some of the burden for escaping or avoiding spins. The problem is how to train today's pilots: Should we emphasize hands-on experience in spins at high altitudes, or less risky—and possibly less effective—ground school?

The U.S. Navy training command recently took the first tack, increasing the number of spin-training flights for pilots from one to three. A debate continues about whether spin-recovery training should be required to get a private pilot's license.

The debate came to a head last summer when conflicting testimony was presented to the Subcommittee on Investigations and Oversight of the House Committee on Science and Technology.

On one side of the fence, the National Transportation Safety Board, the Experimental Aircraft Association and veteran test pilots Tony LeVier and Scott Crossfield strongly advocated spin training for all pilots.

Crossfield supported his protraining position with a bit of history. Prior to World War II, he said, spin accidents accounted for about two-thirds of all fatal accidents. After spin familiarization was added to civilian-pilot training in 1938, spin accidents were reduced to less than half of the total fatalities.

On the other side, the FAA, the General Aviation Manufacturers Association and the Safety Foundation of the Aircraft Owners and Pilots Association concluded that the current FAA policy of teaching only stall avoidance is adequate. They pointed to the practical difficulties of modifying or replacing the many existing training aircraft that are not certified for spin practice.

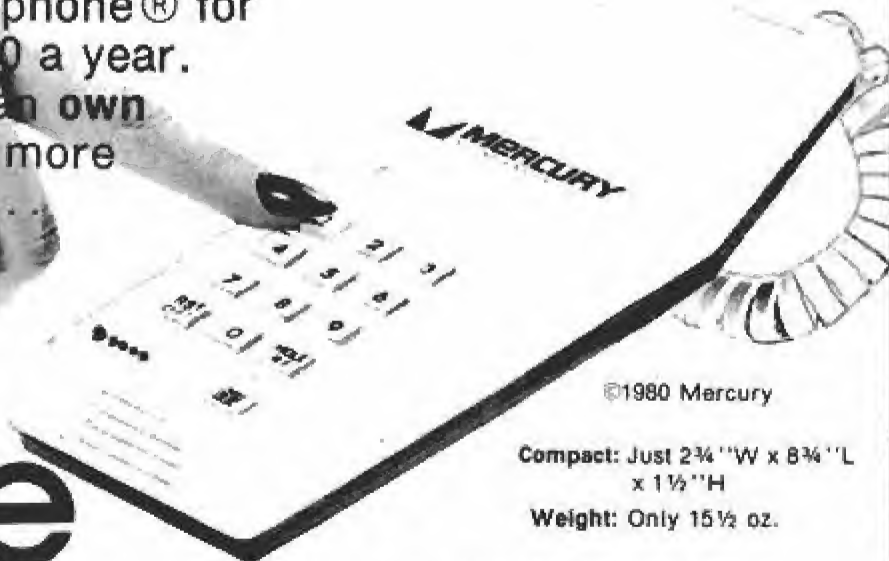
The jury is still out

As we go to press, the debate continues. The committee that heard the testimony recommended that spin training be required for private pilots, and suggested funding for a study on how training should be conducted. There was no guarantee, however, that the committee recommendations would be followed by the new Congress.

But if NASA design research proceeds the way space agency officials hope it will, the argument will become academic. Pilots of the future may view spinning an airplane the way today's drivers view spinning a hand crank to start a car. NASA's goal—and it may be reachable—is to bury the old well-digger once and for all.

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The Porsche 928 (top) was one of Stirling Moss's favorites. He described its handling as "superb." The car came shod with Pirelli P7 tires, which work like glue on the track. The 928's little brother, the 924 Turbo, worked equally well on track and street.

PM's MILLION-DOLLAR CAR TEST

(Continued from page 117)

with a claimed 330 hp, is embarrassingly mundane compared to something like a five-liter, flat-12 Ferrari Boxer with double overhead cams.

But the Pantera was the most consistently excellent car in our test. When the results were tabulated, it had finished second or third in every performance category—and it costs only half as much as the second-place machine. That was enough to put it at the top of the overall list.

Stirling Moss best explains our ambivalent attitude toward the Pantera. "It really is a sharp-looking machine, and quite

nicely appointed inside. I like the gated ZF five-speed gearbox, and the engine really delivers a tremendous amount of torque. It's a real boy racer. The road-holding is quite good, and the brakes are superb.

"And yet I don't like it very much. I don't feel part of the car—I feel like a pimple on a piece of pork. I don't have that feeling of security that one wants, that I could throw it into a corner and it would help me. I wouldn't want to find myself in trouble with it."

The inescapable fact, however, despite our lukewarm feelings for the car, is that the Pantera performed better, and was as well put together, as any of the more expensive Italian "thoroughbreds."

The interior is all Connolly leather, with a neatly laid-out leather dashboard fitted with huge, round, white-on-black instruments.

The interior is much more spacious than either of the Ferraris or the Lamborghini. It was obviously sized to fit Americans rather than Italians, probably because Ford was involved with the design.

Everyone complained about the seats, which have no lateral support and are mounted much too low in the car; the throttle, which is way too high; and the shift linkage, which was misaligned on this particular car.

As is the case with all of these mid-engined cars, both rear vision and luggage space are essentially nonexistent. But that's the compromise you make in order to get the engine behind the seats.

As Phil Hill says, "The Pantera is very good when you've missed an apex through overindulgence, or in some other emergency. You can do little tricks with it you couldn't do with a front-engined car, and actually cut yourself a new apex."

The Pantera GTS is the best bargain in the whole world of mid-engined, high-performance exotic cars. It has everything that a Ferrari has except that indefinable something. Breeding? Class? Sophistication? Whatever it is, the Pantera doesn't have it. But, obviously, it's not something a Pantera needs.

BMW M1

By all rights, the M1 should have walked away with this test. As Phil Hill says, "It's a fantastic racing machine." The BMW won every performance category by a clear-cut margin, except for braking. And we have the sneaking suspicion that its relatively poor braking performance—if 70 to 0 in 181 feet can be considered poor—was due to a mechanic's misadjustment rather than a design deficiency. On the other hand, for \$115,000, you have a right to expect absolute perfection.

The M1 is a real racing machine used for the Procar series which accompanies

The Ferrari 512 BB is an awesome handler and has almost limitless reserves of power. It's as fast as it looks—and then some.





Mercedes 380 SL (top) and BMW 633 CSI (above) have impeccable road manners. Unless owners take the cars on a racetrack, most will never explore the cars' full potential.

European Formula One races. It's at the very limits of technology, with a 3453-cc, double-overhead-cam Six with hemispherical combustion chambers, four valves per cylinder and fuel injection. The mid-engined chassis is equally advanced, with four-wheel disc brakes, all-independent suspension and all the rest that you would expect in a modern racing car.

The detuned street engine is rated at only 270 hp, but the Kevlar fiberglass-bodied car only weighs 2800 pounds, so performance is terrific.

Unfortunately, the M1 presents some serious compromises in order to achieve its racetrack performance. Visibility is poor and, as Hill says, "The fit and finish simply aren't up to Porsche/Mercedes standards—and those cars cost considerably less."

In addition, you have to be a racing driver to get the most out of it. Phil says, "The tail end will step out on fast turns, which is very disconcerting since you don't get a second chance at these speeds."

Stirling Moss has pretty much the same reaction. "I don't feel as comfortable in this car as in many of the others. It has substantial oversteer in fast corners, and is rather vicious near the limit. You'd best know what you're doing and have your mind on your work."

The BMW M1 is a modified road racer; the Porsche 928 is purely a street machine. And yet the 928 was only 2½ seconds slower around the Ontario road course.

The lesson here is that the comfort, convenience, price and serviceability compromises that you must make to own a car like the M1 simply aren't worth it in the real world.

The automobile's styling is spectacular, granted, and the performance is outstanding. But for \$115,000, you should get a car that makes you feel good, too. The M1 doesn't.

Porsche 928

The star of our test is the 928. At \$38,000, it is still in the "expensive" rather than "breathless" price category. It's a perfectly usable everyday car styled like an automobile rather than a spaceship, yet it outperformed almost everything else which we were able to pit it against.

Phil Hill says, "The 928 must be the most highly developed road car there is. The minute you drive away, you can feel the sophistication. It's quiet, has impeccable manners, the controls are just right and even though the chassis is front-engined, the Porsche is so good it allows you to get away with all sorts of sloppy driving that the M1, for example, would never tolerate. Everything about it is top class."

"A terrific, terrific car," says Stirling Moss. "Absolutely superb. It has very good adhesion with the Pirelli P7 tires—they develop quite strong cornering forces and give very smooth transitions. The chassis is very well balanced, with hardly noticeable understeer, then slight

(Please turn to page 172)

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CAR TEST

(Continued from page 171)



At \$97,000, Aston Martin Volante is most expensive two-seater convertible on market.

roll oversteer on the overrun. There's a super amount of smooth engine performance in a straight line from the big overhead-cam, 4.5-liter V8.

"The gear lever is a bit balky because of the remote linkage needed for the rear-mounted, five-speed gearbox, and the leather interior isn't quite as well finished as in the Mercedes. But I'm very comfortable in the cockpit, the controls and instruments are all in the right place and I can see out all around. The 928 really is a genuine 2+2 road car with a decent bit of luggage space, which most of these cars aren't. One can do absolutely great things with this car."

Cars really do have a personality. The Porsche 928 is friendly and inspiring—an energy-giver rather than an energy-drainer. It makes you a better driver than you are, and provides a tremendous feeling of security as well as high-speed indestructibility.

This is one of the few cars in this test that you could load up with a month's worth of luggage and point toward the opposite coast with the sure knowledge that you'd get there safely, in style and happier than when you started. It's a machine of inherent quality and a dirt-cheap bargain, besides. And, as Phil Hill says, "It's the most sophisticated car in this test—the undisputed star."

Lamborghini Countach

The Countach is the weirdest, most seriously compromised car we tested, though the chassis is surprisingly good. As Stirling Moss explains it, "It's like chatting up a spectacular bird in an evening dress at a party and finding out she's brilliant, witty and an Olympic horsewoman, besides."

The Countach was designed to out-Ferrari Ferrari. It has a four-liter, all-alloy V12 with double overhead cams that produces over 350 hp. The engine is behind the seats with a five-speed trans-axle, and the rest of the chassis is state-of-the-art with independent suspension, disc brakes and all the other good bits.

The Countach was either second or third in all the acceleration and handling tests, although, like the BMW M1, it fell down on braking. Says Moss, "The Countach has nice, neutral, light steering, with mild, consistent oversteer. Fast roadholding is very good, much better than you'd expect from a car that looks like this weird. The rear suspension judders on hard acceleration and the gearbox requires a harsh, hard shift. The motor is very noisy. There's an enormous din, but it has a lovely amount of power."

Moss wasn't so sanguine about the styling of the aluminum body. "It has to be

(Please turn to page 174)



The Duntov Turbo Corvette upheld the honor of American sports cars very well against the high-priced foreign competition until overheating problems forced it out of the action.

A comparison of projections from manufacturers' treadwear ratings under the new government Uniform Tire Quality Grading System indicates that on a government-specified course:

Uniroyal Steeler projected to last 15,000 more miles than comparable Goodyear or Goodrich tires.

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On that course, the mileage projection for the Uniroyal Steeler is 66,000 miles.

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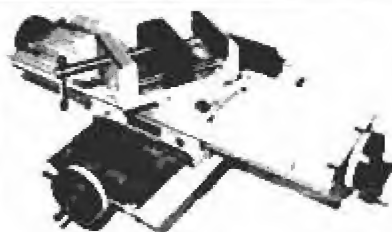
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MILLION-DOLLAR CAR TEST

(Continued from page 172)

the worst car to sit in that I have ever entered. I'm positioned so I'm looking down at my feet with my head scrunched against the roof. It's like sitting in a tea-cup. The seats have good lateral support and all the controls are easy enough to find, but the position is awful.

"Visibility is poor out the back and sides. When you look out the back, your first instinct is to take avoidance action—there's so much coming up behind you. And the damn lift-up doors are the most inconvenient I've ever seen. And these windows! For 50,000 quid, I'd like windows that open more than two inches, especially when there's no airconditioning to speak of and all this engine heat."

The Countach is almost unusable as a road car. It's incredibly uncomfortable, hot, cramped, noisy and almost impossible to see out of. Not to mention the total lack of luggage space, the nonadjustable seats, the need to open the doors just to drop a coin in a toll collector's palm.

There can't be a Countach in the world that actually gets driven on any sort of regular basis, except by attention-crazed masochists to whom being seen is more important than being comfortable. The shame of it is that the body could be easily reworked to be much more functional without sacrificing any of the performance or style.

Ferrari 512 Boxer Berlinetta

The Ferrari that Lamborghini is trying to "out-Ferrari" with the Countach is the 512 Boxer Berlinetta—a mid-engined, five-liter flat-12 with a sexy Pininfarina body, high-tech specifications and 330 hp. In this market, the big Ferrari BB is the standard by which all others are usually judged. Certainly Phil Hill, who spent eight years on the Ferrari team and brought them a world championship, was predisposed toward any Ferrari—as all of us were, really.

Perhaps it was this high level of expectation, but we were disappointed. The 512 did reasonably well everywhere except on the skidpad, and the brakes must have set a world record for street machines, stopping the car in just 129 feet from 70 mph. But the 512 wasn't anybody's favorite car.

As Phil says, "Driving is seriously compromised by the awkward seating position. There is total lack of support from the seats, and my head hits the roof. I'm literally hanging on by the steering wheel, with barely time to steer. I also can't heel and toe the way I'd like, and the clutch, shifter and steering are all much too heavy. The car feels very big on the road. If you overcook it once and get the tires hot, it oversteers much too much. It also rolls too much in high-speed transitions."

Stirling Moss felt "It's not as fast as you'd expect. It has a very firm ride, with disconcerting clunks from the suspension. It understeers in slow corners, then oversteers when you back off. The 512 doesn't handle as well as either of the Porsches, I'd reckon—it's not as delicately responsive. I don't feel the confidence I should in a car of this type."

Ferrari 308 GTSi

The Ferrari 308 is the car we all expected the 512 Boxer to be. It didn't score particularly well in any of the performance categories except braking, but it was the one car in the test that got everyone talking subjectively about breeding and charisma.

The 308 has been around for four years, and has one of the most unusual layouts in production. The three-liter, all-alloy, double-overhead-cam V8 is mounted transversely behind the seats and drives a five-speed transaxle. The rest of the Pininfarina-styled car is very similar to the 512 Boxer, though seven inches shorter and 700 pounds lighter.

This makes a big difference. Where the 512 feels ponderous, the 308 feels light and handy. "Everything is well balanced," says Phil Hill. "There's an admirable precision of control in the brakes, gearbox, throttle and steering that is hard to fault. The 308 just has a feeling of refinement not shared by most of the others."

"That doesn't mean it's the best car. The 308 is not as forgiving as the similarly laid-out Maserati Merak. It has very bad oversteer, all arms and elbows, and once you get the tail out, you can't get it back in. This particular car also had a bad distortion in the windshield glass, which made it hard to see out the front. But overall, I'd say it's the best of these mid-engined, racetrack-derived machines. There's just something about a Ferrari that always seems to come through."

According to Moss, "When you put your foot down, it is quite noisy inside. It's a jolly good noise, but this isn't a social car, except that you can pick up social people—people who'd like to be sociable with you because you've got a Ferrari. In England, we call this a 'bird cage,' because the ladies like it."

"At no time does it feel stunning, and yet you can put up quite high average speeds without much effort. It's fairly fast, even though it doesn't give that impression. But the breeding does come out. If you know what you are doing, it will go very well indeed. There's no doubt this is a beautifully bred motorcar. 'Grace under pressure,' I guess you'd call it. For my money, the 308 GTSi should cost twice as much as the 512 Boxer, not the other way around."

Porsche 924 Turbo

On the first day of street testing, we uniformly hated the 924. It seemed slow, noisy, uncomfortable and not very well

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put together. The engine sounded like it would explode whenever you revved it up, and the gearbox was consistent only in its inconsistency. Even with a price tag approaching \$30,000, the 924 felt like a cheap pretender in a field of thoroughbreds.

This feeling persisted on the second and third days. The 924 was boringly slow on the drag strip, and only mediocre in every other performance test. The only exception was the skidpad, where the 924 finished third behind the M1 and the Pantera, almost solely on the strength of its optional, and incredibly sticky, Pirelli P7 tires.

Then we got to the racecourse, and hate turned to love. Says Phil Hill, "This little guy is the most surprising car. I didn't like it at all on the road, but on the track, it's great! It has a marvelous high-speed forgiveness, with tremendously vice-free handling. I'd say this was the biggest surprise of the day—it really does handle well."

Stirling Moss had the same reaction. "The 924 just isn't in the same league with the 928—in no way does it compare with its bigger brother. There's no power from the two-liter, Audi four-cylinder, even with a turbocharger, and it's not half as well thought out. But the handling is quite neutral, and so it actually goes quite quickly on the track. It's easy to drive near the limit, since there's no understeer as long as you keep the power on."

"If I had to sum up, I'd say it's a case-book lesson on how good modern tires have become. Simply by fitting these terrific P7 tires, they've turned what really isn't a very good car into quite a decent handler. I don't think I'd much like this car without these tires. The 924 simply hasn't got it all together. It's like a jelly that's not yet set—it needs to be molded in the Porsche way."

Duntov Turbo

Robert Schuller, the president of American Custom Industries which makes the Duntov Turbo, is emphatic that his car is not a Corvette.

But to us, it sure looks a good deal like a modified Corvette. It's fitted with new headlights, fat wheels and Goodyear Wingfoot tires, equally fat fenders and a dressed-up Corvette interior of red plush with digital instruments. Most important, the Duntov is a convertible, which Chevrolet doesn't sell any more, and it has a Turbo International 4-psi turbocharger bolted to the stock 5.7-liter V8 and three-speed automatic.

The result is either a very expensive Corvette or a bargain exotic car, depending on your point of view. It finished exactly in the middle of the pack in this test. It was slower than anyone expected from a 3300-pound car with a turbocharged V8 and claimed 260 hp, but it also handled better than we expected and

(Please turn to page 176)

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MILLION-DOLLAR CAR TEST

(Continued from page 175)

was far more comfortable than a Corvette has any right to be.

Phil Hill liked it. "It goes quite well, really. The handling is generally pretty good, very forgiving. It searches for oversteer to understeer in hard cornering, but has a strange way of saving itself. It's not dangerous, just unpleasant when you're really in a hurry. It does have terrible understeer at the very limit—the only redeeming feature is that you go off the road frontward. But at eight-tenths, say, the behavior of the car is very predictable."

According to Moss, "It's hard to see very well, because of the body shape. And the wide rear fenders seem to be sticking out in the way when you're trying to hurry. Still, I fit in the thing quite well, and the seats have excellent lateral support. I don't much like those red digital instruments or the black-flock trim. I do like a topless car for touring, so the Dunlop appealed to me for that reason. But I'll tell you, boy, if I were going to spend \$38,000 or whatever it is, I'd rather have a Mercedes 380 SL."

Manta

The Manta was the most fun of any car in this test. A kit car—you get the frame and body for \$7795 and supply the rest yourself—it's meant to look like a McLaren Can-Am car from the early '70s. There's no top, no luggage space, not even much passenger space, really. But it feels like any boy's idea of what a racing car should feel like—noisy, uncomfortable, windy—and more fun than anything this side of a Formula Ford.

Because it's a kit, every Manta is different. This particular one had a Volkswagen Beetle front suspension, a Corvair rear transaxle and a stock 250-hp, five-liter Chevrolet V8 behind the seats. Even with this "cooking" engine, the lightweight Manta was just a whisker slower in acceleration than the lead four, all of which cost three to five times as much. With \$500 worth of engine hop-up parts, the Manta could have easily won at the drag strip. It was also surprisingly competent everywhere except on the track and skidpad—graphic evidence of its inherent good design, but unsorted suspension.

Phil Hill says it best. "With just a little bit of development work on the suspension, this would be a very nice little fun car, and one that you'd have to take very seriously, indeed. As it is, this particular car understeers very badly. The rear suspension judders like mad accelerating out of a turn, and the steering is very heavy. But all that is a function of the fact that it was completed the week before our test, and had never been really driven before."

Stirling liked it, too. "The cockpit is tight, but it fit me quite nicely. There's enormous torque, and you can get a lot of that power to the ground. The cornering is

surprisingly flat, but the thing understeers horribly. But that can be fixed with the proper sway bars and stiffer dampers. The brakes and steering are okay, but the Corvair gear selector is not its strongest point.

"It's pretty good for what it is—a bit of this and a bit of that. I must admit I didn't push it as hard as I did some of the others, because you really don't know how good the chap was who built it. Conversely, it never gave me a moment's pause. And it certainly looks lovely."

Maserati Merak

The Merak is Maserati's competitor for the Ferrari 308 GTSi. Though it costs \$10,000 less, it is almost directly comparable to the 308 in performance—a second slower on the track, a hundredth of a second slower on the skidpad, four-tenths faster in slalom, nine feet longer in braking, 2 mph slower at the drag strip. But like its sibling Pantera—both companies are owned by Alejandro DeTomaso—the Merak lacks that certain charisma that makes a Ferrari a Ferrari and a Maserati the Dodge of exotic cars.

On paper, the Merak looks terrific. The superb body is by Giugiaro, the master among Italian stylists, and though it's 10 years old, it still looks great. The mid-mounted, three-liter, double-overhead-cam V6 was inherited from the Citroen SM, back when Citroen and Maserati were allies. It's smooth and quiet, though no ball of fire. The Merak chassis is as sophisticated as any around, and the workmanship equals Ferrari's.

Like the Pantera, the Merak seems designed for American bodies; there's more headroom, legroom and shoulder room than in the cramped Ferraris or Lamborghinis. Visibility and luggage space are limited, as in all these mid-engined designs, but the Merak's body is probably the most practical of any of these ultra-exotic cars. The one feature the Ferrari 308 GTSi offers that the Maserati doesn't is a lift-out, Targa-style roof for quasi-convertible motoring.

But everyone would still rather have the Ferrari. As Phil Hill says, "The Maserati just doesn't seem all-of-a-piece. There's not much lateral support to the seats, so your body falls all over the place. There's no dead pedal for your left leg, and the clutch is hard to use. It understeers, and gets a bit touchy at high speeds, but there's a tendency to oversteer under braking, which can be a bit of a handful unless you know how to control it. It's generally well behaved, but not inspiring."

Says Moss, "The interior is pretty nicely detailed, though I'm not mad about slippery leather upholstery in a sports car. You can beat the gear-lever synchros, and there's not much power at high speeds. The steering feels a bit too light to me, much like the Pantera's, and the

(Please turn to page 178)

4 new ways to use rubber sealant

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In using sealant, make sure surfaces are clean and dry. A tight,

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MILLION-DOLLAR CAR TEST

(Continued from 177)

chassis feels a little unstable. It's really quite a good car, I suppose, but rather colorless and flat—like Beaujolais that's sat out too long."

Lotus Esprit

Another Giugiaro design, the Lotus Esprit is an updated version of the old mid-engined Europa, fitted with a high-style Italian body originally done nearly a decade ago as a one-off show car. At 1980 pounds, the fiberglass-bodied Lotus weighs hundreds of pounds less than any car except the Manta. Its performance is still reasonable, even with a 1973-cc engine, the smallest in the group.

As Phil Hill says, "The Lotus is an interesting little car because it's so very different in conception from the other cars. It's very small, very light, with an extremely low polar moment of inertia and a low center of gravity. This means it has very nice manners and very predictable handling. It's really not very fast, though, and the attention to detail isn't very good."

It's unfortunately true; Lotus cars still have that stigma of "kit" about them. Indeed, the Manta kit car feels less like a kit car than the Esprit. The Esprit is the kind of car that you drive rather gingerly, half expecting bits and pieces to fall off at any time. It's not a car for a long trip.

Buying a Lotus means giving up nearly all the attributes of a normal car—comfort, luggage space, visibility, reliability—in order to enjoy exceptional transient handling feel. On the other hand, that wonderful handling is mostly subjective impression, not objective fact. The Lotus was 10th in the slalom and 12th on the track, behind many less compromised machines. Still, it *feels* good.

As Stirling Moss says, "This is obviously a race-bred machine. The balance of the car is very impressive, it handles very well, and the transition from left to right is very easy. There's slight oversteer, but a great feeling of confidence in a corner. It's a real boy racer."

But not a man's car.

BMW 633 CSI

Like the Porsche 928, the BMW is marvelously sophisticated, but from a quieter, everyday point of view. If she were a woman, she'd be a tall Teutonic blond with superb taste in clothes and rather competent, if not brilliant, at almost anything—the sort men marry rather than the sort they die for.

If, like most people, your needs in a street machine include 2+2 seating, a trunk that can accommodate half a dozen grocery bags, a comparatively reasonable price, good resale value and over 20 mpg cruising, it's probably the most sensible buy in this test. It's also one of the few cars on which the workmanship and detailing seem worthy of the price tag.

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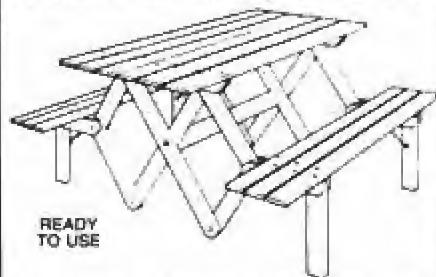
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Phil Hill says it best. "The styling, the interior, the trim, the details, the instruments are of a very high order. The interior layout is very functional, with no raw edges, no unwanted reflections, nothing to distract from the business at hand. This is a very comfortable, secure road car, not a racing car.

"It's a very quiet car, the 3.2-liter Six is very smooth and willing, the gear change is excellent, the steering is light and precise, the brakes are decent. Of course, with a soft suspension, it gets very twitchy at high speeds near the limit, and there's too much body roll in the transients on the track. But it certainly is well put together for the streets."

Jaguar XJS

The XJS performed much better than we expected. The brakes are excellent, and it did pretty well on the track, where the torquy 5.4-liter, overhead-cam V12 towed it along at a reasonable rate, considering the 4000-pound curb weight and three-speed General Motors Turbo-Hydramatic. All that engine weight on the front wheels showed up in the handling tests, though, where the XJS was consistently at the bottom of the heap.

Says Moss, "The Jaguar is a very smooth, very strong touring car. The serious understeer can really take you by surprise—it really leans on the front tires. But you can get the back end out a bit, if you just roll off the gas going into the corner—quite impressive for a car of this type. For my taste, the servo-assisted steering is much too light, with not enough self-centering action."

Phil Hill had a virtually identical reaction. "You need great armloads of lock, and the steering is too light and not very responsive. The tires feel very slippery, and it has massive amounts of understeer. But the car is quiet and smooth. It also has this wonderful wood and leather British interior. I don't much respond to the exterior styling, though, and the whole package seems dated."

DeTomaso Longchamp

A couple of years ago, Alejandro DeTomaso added the Maserati factory to his myriad automotive holdings. It was a matter of a moment for DeTomaso to restyle the grille of the nice Maserati Kyalami coupe, drop in the same 5.7-liter, 330-hp Ford V8 used in the Pantera, rename it the DeTomaso Longchamp 2+2 and reduce the price by 3 million lira.

"The result," as Phil Hill points out, "is a tremendous surprise for a front-engine, boulevard-type luxury car. Its great virtue is moderate but consistent understeer. The engine is willing, the aerodynamic stability is excellent. No DeTomaso has the perfect finish of an exceptional car like the Mercedes, but this Longchamp is very decently put together."

Says Moss, "The Longchamp is very

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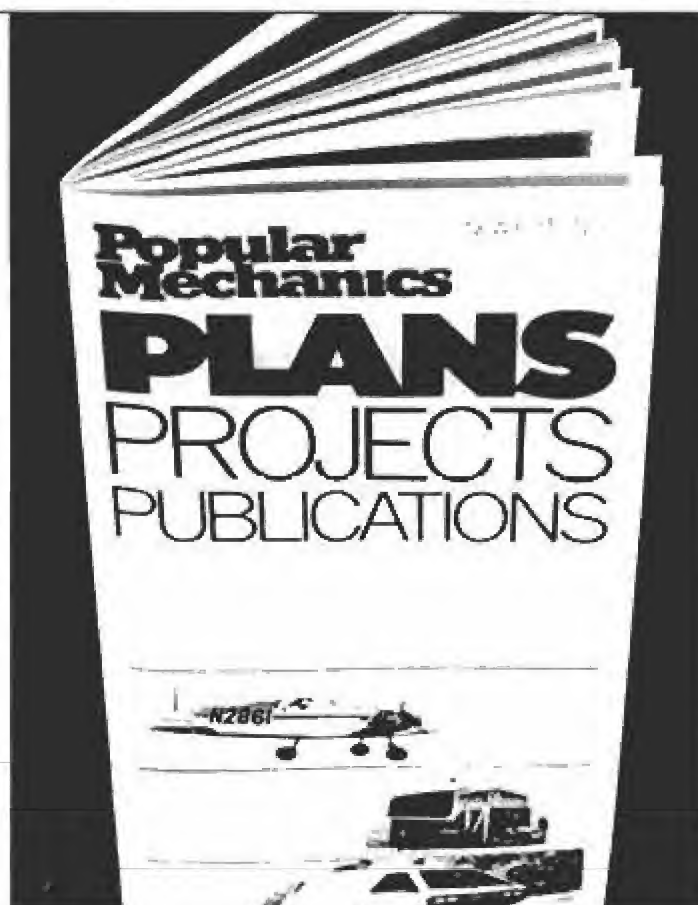
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MILLION-DOLLAR CAR TEST

(Continued from page 179)

good-looking, one of the snappiest occasional four-seaters I've seen. I can get myself into a position where I can drive it quite well; I'm comfortable, the instruments are complete, the black leather interior is acceptably finished. The whole car is a bit more agricultural than the Mercedes, for example—a bit rough all around, but certainly acceptable.

"Unfortunately, it understeers badly. The steering is imprecise, the transmission is rough and there's a serious vibration that starts at 100 mph and won't go away. Right/left/right transitions require too much steering. I don't have the feeling of confidence I get with the Mercedes; the handling simply isn't as good. To be honest, I lack confidence in the Longchamp, confidence that it will do what I intend."

Aston Martin Volante

If there was a "performance-per-dollar" index in this test, the Porsche 928 would be first and the Aston Martin Volante last. For \$98,000, you have a right to expect much more. The Volante looks a lot like a 10-year-old Mustang convertible, and it doesn't seem to be too well assembled.

Its best features are a plush interior, which seems to have been dipped in tan Connolly leather, and a convertible top that allows open-air motoring for 2+2. The 5.3-liter, double-overhead-cam V8 produces lots of power, but the 4000-pound curb weight and automatic transmission conspire to slow it down. Still, on the racetrack it surprised us all.

"There's pronounced understeer and a good bit of wallow on slow corners," says Moss, "but it feels dynamically very stable on fast corners. It's underdamped on a racetrack, but has an excellent ride for the street. The driving position is good, with excellent visibility. The steering has a nice solid feel, and the brakes are predictable. And, of course, the top retracts, which I, personally, like."

Says Hill, "For a big, heavy, front-engined car in the luxurious British tradition, it has remarkably good road manners. With most cars of this type, the tires practically roll off the wheels in hard cornering. I think it does fantastically well, considering the luxury/boulevard car parameters around which it was designed."

Mercedes-Benz 380 SL

The 380 SL—which is the 10-year-old 450 SL roadster fitted with the smaller, all-alloy, 3.8-liter V8 that's just been introduced in the new S-class sedans—is in the curious position of finishing last in this test, but being everyone's favorite.

Phil Hill explains this curious anomaly. "The Mercedes exhibits a sophistication of roadholding that simply can't be described. It has impeccable manners on

(Please turn to page 183)

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MILLION-DOLLAR CAR TEST

(Continued from 181)

the road, but it's incredibly forgiving on the track, as well. It would be almost impossible to get into trouble with this car. No matter what you do to it, it goes into a gentle correction by itself.

"It's not a racing car, but an incredibly fine, high-speed road car. It has a large trunk and a comfortable interior—and, of course, it's probably better built than any car here. Everything about it—the brakes, the steering, the four-speed automatic transmission, the smooth V8 engine—is just marvelous. And maybe most important, at the end of the last lap, it's every bit as good as it was at the beginning of the first. I could go on all day. A truly remarkable car."

Stirling Moss is just as taken with the Mercedes. "I am awestruck—by the silence, the effortlessness, the smoothness and comfort. The workmanship is outstanding. The chassis is especially impressive—remarkably neutral handling and lovely balance. It combines a soft ride with excellent handling. It's also very stable down the straights. This is a delightful car to drive quickly—beautifully engineered in every respect. The driver and passenger enjoy a great feeling of confidence and security. It really is a superb car."

Conclusion

Unanimously, we nominated the Porsche 928 as the car we'd most like to own for street driving. It didn't win the test, but it's our favorite. Although the Pantera scored the highest number of performance points, and can technically be called the "best car in the world," it's not the car we'd buy.

The 928 is far and away the "best value for money," as the British say. It shares with the Mercedes 380 SL an uncanny combination of quality, refinement, sophistication, strength and security that lesser machines can't touch, even the ones in this rarefied group. Plus, the Porsche 928 flat digs in and flies.

We'd say that the 928 is the best automobile for sale in the world today. How do we know? Because we just spent four days driving the 15 other candidates that can even pretend to be in the race. **PM**

HONORABLE MENTION

For services rendered above and beyond the call of duty, and without whom this road test would never have happened, we'd like to thank the following:

Bob Butte, Pete Mills, Rob Swartwout, The British School of Motor Racing, Susan Moss, Betty Trimble, the Ontario Motor Speedway staff, Charles Albert of SetCom Corp., Col. Lucius Taylor, Panasonic, Jas Rarewala, Radio Shack, Earl from The Mayonnaise Farm, Russ Collins, Bob Chambers of Kustom Industries and all the manufacturers and importers who loaned us the cars.

Special thanks to Michael and John Lamm.

WATER FROM OUR OWN BACKYARD WELL

Opelika, Alabama—What can you buy for a nickel and still get some change back? 500 gallons of water, that's what! As a matter of fact, the electricity to pump 500 gallons from your own backyard well costs only four cents!

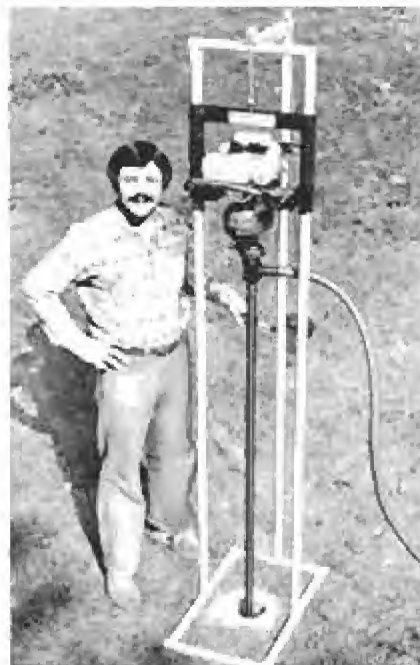
With this reliable, convenient source of water you can supply your home, your garden, and with a water well heat pump you can even heat and cool your home for a fraction of the cost of conventional systems!

In the past, the cost of drilling a well made it uneconomical for anyone who could hook on to city water mains. However, as city water becomes much more expensive, backyard wells have become more and more popular. To hold the cost of drilling a well to an affordable level, an easy-to-use low-cost machine has been developed for the homeowner who wants to drill his own. Called the *HYDRA-DRILL*, it is already in use around the world, and an estimated 50,000 Hydra-Drill wells have been drilled to date.

The Hydra-Drill can drill to depths of 200 feet, which puts you within reach of 90% of all the good fresh ground water in the world. The typical Hydra-Drill well can produce over 4,000 gallons of water each day—just compare that with the average U.S. family consumption of 500 gallons of water per day!

The Hydra-Drill is remarkably simple to operate. It is completely portable, and can be operated anywhere... even in places a truck-mounted drilling rig can't get. Yet it can drill most anything the big, truck-mounted rigs can drill, and drilling speeds range up to 40 feet per hour.

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water well, send your name and address to: DeepRock Mfg., 5301 Anderson Road, Opelika, Alabama 36802. Or phone toll-free (800) 821-2280 (Ext. 5301). There is no charge or obligation, and no salesman will call. Call anytime including Sundays.

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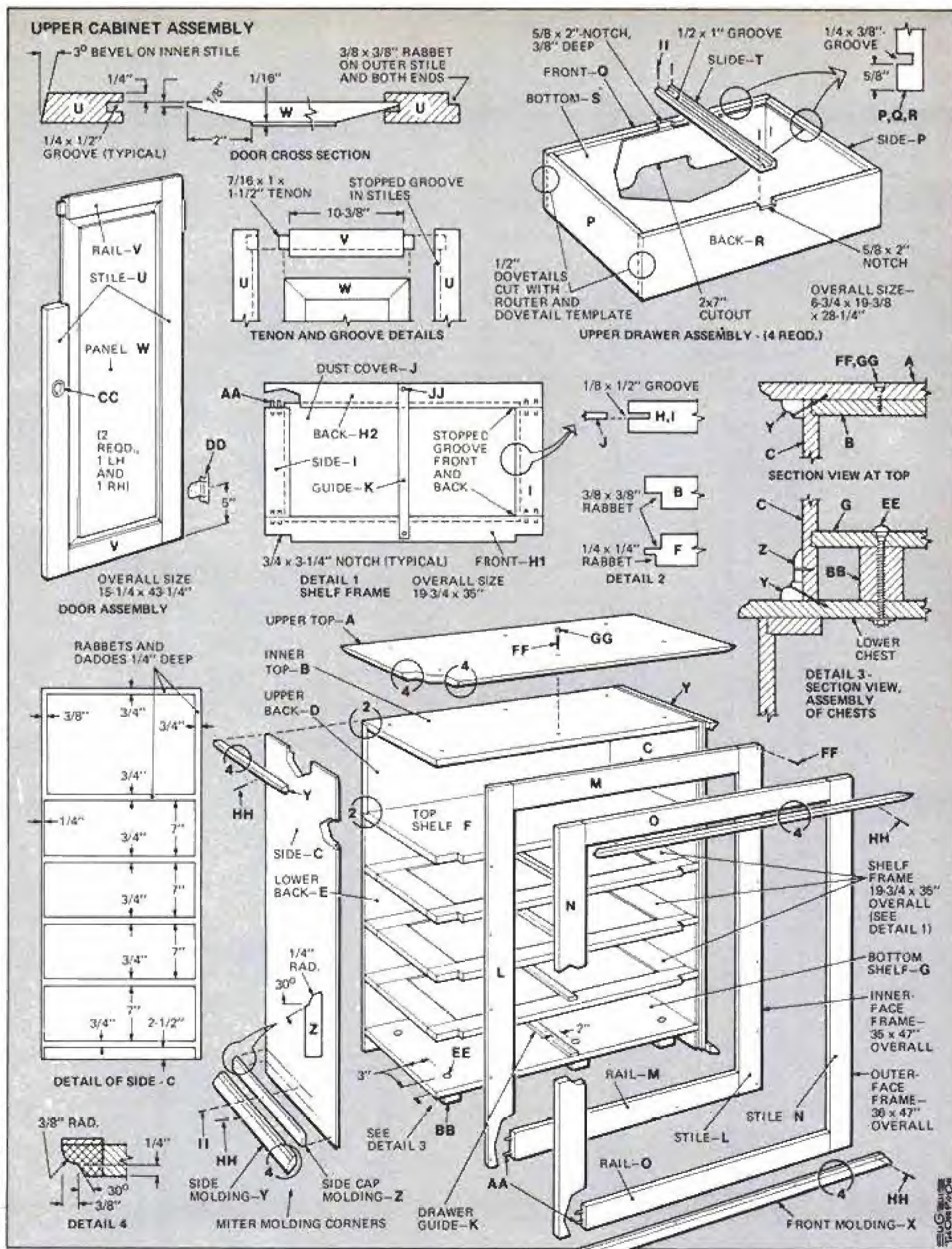
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WARDROBE FOR MASTER CRAFTSMAN (Continued from page 141)

able for any youngster who is willing to expend the necessary time and energy. Last year, for example, 18

cash prizes, totaling \$5100, were awarded to contestants in grades 9 through 12.

Randy Begin of Salem, Mass., a 17-year-old woodworking enthusiast, won a \$300 first prize with the armoire shown. Tutored by shop

instructor Michael Voolich, Randy spent two terms building the armoire.

Basically, the armoire consists of an upper and lower chest. It's made of American black walnut with a hardboard back. Some oak was used in the drawers, and for drawer slide construction.

Randy took no shortcuts; for example, he used dovetail joints on the drawers. These were machine-made, using a router and dovetail templet. The raised panel doors were hand-planed, because he wanted to gain the sense of how craftsmen used to create such doors.

You can take the modern ap-

proach and use your table saw and/or jointer to raise the panels. Here are some tips for building the armoire:

- Check drawing and measure carefully when laying out the walnut parts. Walnut is expensive.
- Build cabinet one case at a time.
- Sand all parts before assembly. Final sanding on raw wood should be done with a 150-grit abrasive.
- Test-assemble the parts without glue first—make sure the parts fit together before final assembly.
- You can finish the armoire with a rubbed oil finish, such as Watco Danish Oil.

Judges for the 1980 Stanley contest (left to right): Jephson J. O'Connell, interior decorator, G. Fox & Co.; Walter Winkler, cabinetmaker, design department, Hitchcock Chair Co.; Harry Wicks, PM Home and Shop Editor; and Herb Siegel, director, New York City Board of Education Industrial Arts department. Paul Muenzen (far right) supervises the contest for manufacturer.



MATERIALS LIST—UPPER CHEST

Key	No.	Size and description (use)
A	1	3/4" x 23" x 40" walnut (top, upper)
B	1	3/4" x 19 1/4" x 35" walnut (top, inner)
C	2	3/4" x 20" x 47" walnut (side)
D	1	3/4" x 12 1/2" x 35 1/2" walnut (back, upper)
E	1	1/4" x 33" x 35" hardboard (back, lower)
F	1	3/4" x 19 1/4" x 35" walnut (top shelf)
G	1	3/4" x 19" x 35" oak (bottom shelf)
SHELF-FRAME ASSEMBLY (3 reqd.)		
H1	3	3/4" x 3" x 35" walnut (front)
H2	3	3/4" x 3" x 35" oak (back)
I	6	3/4" x 4" x 13 3/4" oak (side)
J	3	1/4" x 14 3/4" x 28 1/4" hardboard (dust cover)
K	3	3/4" x 2" x 19" oak (drawer guide)
INNER-FACE FRAME ASSEMBLY		
L	2	3/4" x 3 1/4" x 47" walnut (stile)
M	2	3/4" x 3 1/4" x 28 1/2" walnut (rail)
OUTER-FACE FRAME ASSEMBLY		
N	2	3/4" x 3" x 47" walnut (stile)
O	2	3/4" x 2 1/4" x 30" walnut (rail)
DRAWER ASSEMBLY (4 reqd.)		
P	8	5/8" x 6 3/4" x 19" oak (side)
Q	4	5/8" x 6 3/4" x 28 1/4" oak (front)
R	4	5/8" x 6 3/4" x 28 1/4" oak (back)
S	4	1/4" x 18 3/4" x 27 3/4" hardboard (bottom)
T	4	1/2" x 1" x 19 1/2" oak (slide)
DOOR ASSEMBLY (2 reqd.)		
U	4	3/4" x 2 3/8" x 43 1/4" walnut (stile)
V	4	3/4" x 2 1/2" x 12 3/4" walnut (rail)
W	2	3/4" x 11 3/4" x 39 1/4" walnut (panel)
MOLDINGS		
X	2	3/4" x 1" x 38" walnut (front molding)
Y	4	3/4" x 1" x 21 7/8" walnut (side)
Z	2	3/4" x 1 1/2" x 20 3/8" walnut (side-cap)
HARDWARE		
AA	40	3/8" x 2" dowel
BB	6	2" x 2" x 1/2" poplar (blocks, spacer)
CC	2	door pull—Amerock BP 841
DD	2 pr.	door hinge—Ajax 5896-6
EE	1	3/4" carriage bolt, washer and nut
FF	1	1 1/4" No. 8 th screw
GG	1	1/2"-dia. walnut plug
HH		6d finishing nails
II		1" ribbed nails
JJ		1" No. 8 th screw

■ If you prefer a stain and varnish finish, remember that walnut has an open grain and its pores need filling. You must tint natural paste wood filler with the stain that you use. Brush the filler on the wood, first against, then with the grain. Allow filler to set until it loses its shine, then rub off with a coarse cloth such as burlap. *Note:* The longer paste wood filler remains on the surface, the harder it is to remove; work only on a small area at a time. Allow piece to dry at least 24 hours after filling.

■ Seal the unit with a coat of 3-lb. cut shellac thinned 50 percent with denatured alcohol. When dry, apply a coat of undiluted satin or eggshell varnish. If you want a second coat, sand the first coat lightly with 220-grit paper, dust off and wipe with a tack cloth first. (In a two-coat varnish job, thin the first coat about 20 percent with turpentine.)

Building the piece

The unit is made of two boxes—one sitting atop the other. Build the lower case first.

Start by assembling the drawer slide units, using glue and dowels. When the glue has dried, fasten one side of the case to the slides. Then fasten the second side. Install the

(Please turn to page 186)

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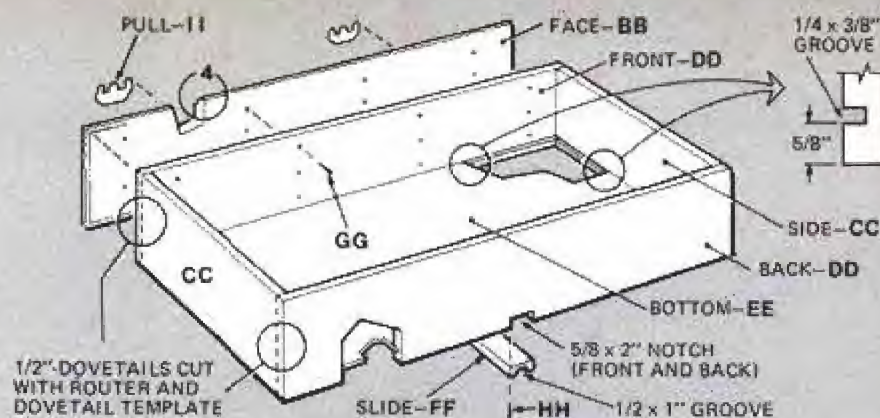


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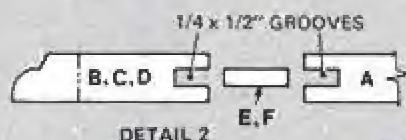
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Diagram illustrating the side detail of the window frame assembly, showing the rabbet and dado dimensions:

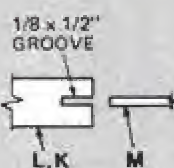
- Top section: 1/4 x 3/4" RABBIT
- Middle section: 1/4 x 1/4" RABBIT
- Bottom section: 1/4 x 3/4" DADOES
- Vertical dimensions: 8 1/2" (twice), 4 1/2", 13 3/4", and 23".
- Label: SIDE DETAIL 1



DRAWER ASSEMBLY **OVERALL SIZE— 7-3/4" x 21-1/4"**
(2 REQ.) **x 35-3/4" WITHOUT FACE**



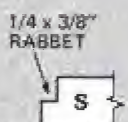
DETAIL 3



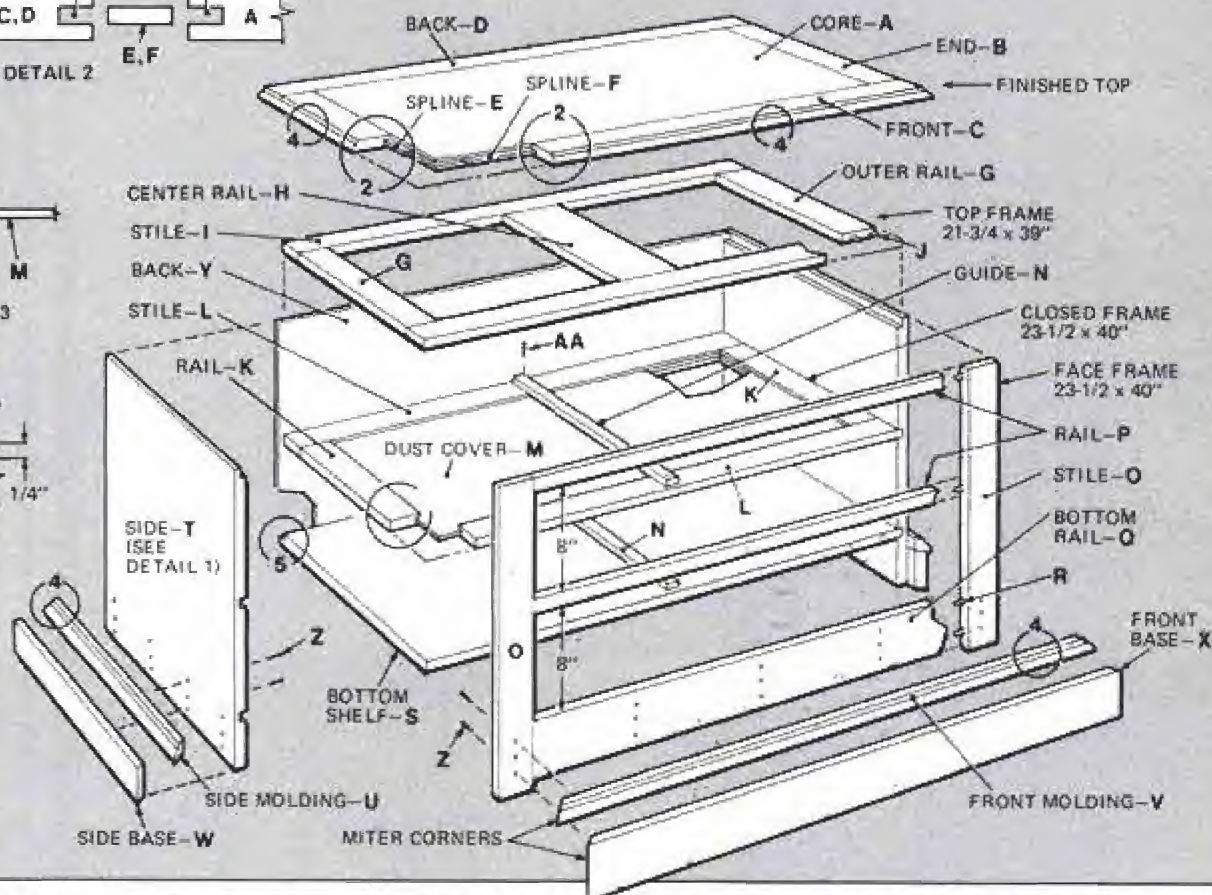
DETAIL 3



DETAIL 4



DETAIL 5



(Continued from page 185)

Now build the drawers. Note that the corners are dovetailed with power equipment. With a router and dovetail templet, the drawer corners can be laid out and dovetailed in a short time.

Complete all carpentry, making

Key	No.	Size and description (use)
		FINISHED TOP
A	1	3/4 x 19 x 36" oak (core)
B	2	3/4 x 3 x 19" walnut (side)
C	1	3/4 x 3 x 42" walnut (front)
D	1	3/4 x 2 x 42" walnut (back)
E	2	1/4 x 1 x 20" birch plywood (spine)
F	2	1/4 x 1 x 35" birch plywood (spine)
		ROUGH TOP-FRAME ASSEMBLY
G	2	3/4 x 2 1/2 x 16 3/4" oak (outer rail)
H	1	3/4 x 4 1/2 x 16 3/4" oak (center rail)

MATERIALS LIST—LOWER CHEST		
Key	No.	Size and description (use)
		FINISHED TOP
A	1	3/4 x 19 x 36" oak (dore)
B	2	3/4 x 3 x 19" walnut (side)
C	1	3/4 x 3 x 42" walnut (front)
D	1	3/4 x 2 x 42" walnut (back)
E	2	1/4 x 1 x 20" birch plywood (spine)
F	2	1/4 x 1 x 35" birch plywood (spine)
		ROUGH TOP-FRAME ASSEMBLY
G	2	3/4 x 2 1/2 x 16 3/4" oak (outer rail)
H	1	3/4 x 4 1/2 x 16 3/4" oak (center rail)
		CLOSED-FRAME ASSEMBLY
I	2	3/4 x 2 1/2 x 39" oak (stile)
J	12	3/8 x 2" dowels
K	2	3/4 x 2 1/2 x 16 3/4" (rail)
L	2	3/4 x 2 1/2 x 39" (stile)
M	1	1/8 x 17 1/4 x 35" hardboard (dust cover)
N	2	1/2 x 1 x 21 1/4" oak (guide)
		FACE-FRAME ASSEMBLY
O	2	3/8 x 2 x 23 3/4" walnut (stile)
P	2	7/8 x 1 x 36" walnut (rail top, 00000)
Q	1	7/8 x 4 x 36" walnut (rail 00000)
R	8	5/8 x 2" dowels
S	1	3/4 x 22 x 39" oak (bottom shelf)
T	1	3/4 x 22 x 3/4" walnut (side)
U	2	7/8 x 1 x 26" walnut (side molding)
V	1	7/8 x 1 x 45" walnut (front molding)
W	2	3/4 x 3/8 x 26" walnut (side base)
X	1	3/4 x 3/8 x 45" walnut (front base)
Y	1	1 9/16 x 39 1/4" Masonite (back)
Z		1 1/4" dry 000 screws
AA		1" No. 8 fl. screws
		DRAWER ASSEMBLY (2 reqd.)
BB	2	3/4 x 8 1/2 x 37" walnut (face front)
CC	4	3/4 x 7 1/4 x 20" oak (side)
DD	4	3/4 x 7 1/4 x 35 3/4" oak (front, back)
EE	2	1/4 x 19 1/8 x 35 1/4" Masonite (bottom)
FF	2	5/8 x 2 x 21 1/4" oak (slide)
GG	24	1 1/4" No. 8 fl. screws
HH		1" No. 16 000000
II	2	Alax #941 (bolts)

sure everything fits properly, before you start the finishing process.

If you have a high-school student in your home who would like to take a crack at the Stanley Contest this year, write to Paul B. Muenzen, Manager, Educational Marketing, Stanley Tools, 600 Myrtle St., New Britain, Conn. 06050, for information.



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IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF
PENNSYLVANIA

PAUL J. BOGOSIAN, et al.
Plaintiffs,

v.

GULF OIL CORPORATION et al.
Defendants

CIVIL ACTION NOS. 71-1137
71-2543

SUMMARY NOTICE OF CLASS ACTION DETERMINATION OF PROPOSED PARTIAL SETTLEMENTS, AND OF AVAILABILITY OF PRINTED NOTICE

TO: ALL PERSONS WHO ARE SERVICE
STATION LESSEE-DEALERS OF THE FOLLOWING
COMPANIES, OR WHO WERE
LESSEE-DEALERS OF ANY OF THE FOLLOWING
COMPANIES AT ANY TIME BETWEEN
MAY 11, 1967 AND DECEMBER 31, 1977:

AMERADA HESS CORP. (Hess), AMERICAN
OIL COMPANY (Amoco Oil Co. or Amoco),
ATLANTIC RICHFIELD COMPANY (Arco), BP
OIL INC. (BP after December 31, 1969, William
Penn or Boron), CHEVRON OIL CO. (Chevron),
CHEVRON U.S.A. INC. (Chevron, except
Arizona, California, Nevada, Washington, Alaska,
Hawaii, Oregon, and Idaho), CITIES SERVICE
OIL CO. (Cities or Cities Service), EXXON CORP.
(Exxon), GETTY OIL COMPANY (Getty, Tide-
water) "Flying A" after September 30, 1967, and
Skelly after January 31, 1977), GULF OIL
CORP. (Gulf), HUMBLE OIL & REFINING CO.
(Esso, Enco or Humble), MOBIL OIL CORP.
(Mobil), PHILLIPS PETROLEUM CO. (Phillips),
SHELL OIL CO. (Shell), SINCLAIR OIL CORP.
(Sinclair) (March 4, 1969 to December 29, 1972
only), SUN OIL CO. (Sunoco, and DX after
October 25, 1968), TEXACO INC. (Texaco),
UNION OIL OF CALIFORNIA (Union 76).

PLEASE TAKE NOTICE that a class action on
your behalf is presently pending under the
federal antitrust laws in the Eastern District of
Pennsylvania. The classes consist of (i) all present
lessee-dealers of the companies named
above, and (ii) of all persons who were lessee-
dealers of those companies for any length of time
between May 11, 1967 and December 31, 1977.
You may be a member of either or both classes,
and, if so, your rights may be affected by this
litigation.

In substance, plaintiffs (those bringing suit)
allege that the defendant oil companies have
conspired among themselves to impose a system
of lease and supply agreements upon their
lessee-dealers as follows: (1) defendants have
required, as a condition to the leasing of a gaso-
line service station site, that the lessee-dealer
purchase gasoline only from the lessor-defen-
dant, and (2) defendants have required their
lessee-dealers to sell only gasoline supplied by
them from pumps bearing their trademarks.

The defendants (the oil companies being sued)
deny these allegations, deny that they have
violated the antitrust laws, deny that their dealer
agreements are unlawful in any respect, and
deny that they are liable to any lessee-dealers
for the claims asserted by the plaintiffs.

Proposed settlements have been reached with
two of the defendants, Getty Oil Company and
Sun Oil Company. These settlements will become
effective if approved by the Court after a hearing
to be held on May 21, 1981, on their fairness,
reasonableness and adequacy. The proposed
settlements do not mean that liability or damages
will be found against the remaining non-settling
defendants.

If you are a member of either of the classes and
have not received, by mail, a more detailed
printed notice, you may obtain a free copy of this
notice by filling out and mailing Part A of the form
below to:

Clerk of the Court, United States District Court
(E.D. Pa.), Post Office Box 1580, Philadelphia,
PA 19105

If you are a member of one or both classes and
have not yet received by mail a detailed printed
notice, you must write to this address in order to
be placed on the mailing list for further communi-
cations concerning this case.

Members of the classes described above,
unless they exclude themselves from the classes,
shall be bound by any judgment or determination
of the Court in this case. You may exclude your-
self from this action, if you, no later than midnight,
April 21, 1981, request exclusion by filling out
and signing part B of the form below and mailing
it to the address above. If you do not exclude
yourself as a member of the class, you may, but
need not, enter an appearance in this action
through counsel of your choosing; otherwise, the
named plaintiffs and their counsel will repre-
sent your interests in this lawsuit.

PART A—REQUEST FOR MORE DETAILED PRINTED NOTICE

(Fill out this part if you wish to receive a copy of
the more detailed printed notice. Please Print.)

Name

Present Home Address

Former Service Station Address

Service Station Brand

PART B—EXCLUSION REQUEST

(Do not fill out this part if you wish to remain a
class member. If you want to be excluded from
the classes, you must do so by April 21, 1981.)

I acknowledge receipt of Summary Notice of Class Action Determination of Proposed Partial Settlements, and of Availability of Printed Notice, and hereby elect to be excluded from both of the classes defined by the Court and from any subsequent litigation that may be hereafter certified.

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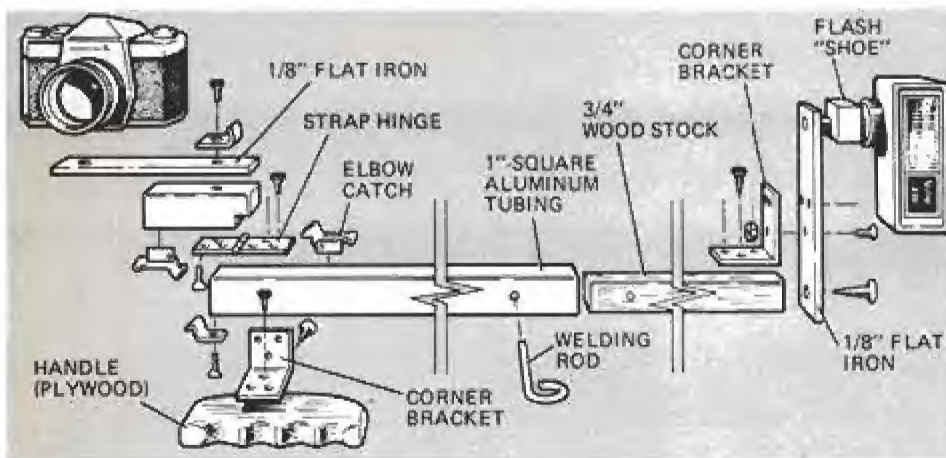
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screw in the tripod socket. Attach the second striker and catch in the same way as the first.

Insert the remainder of the $\frac{3}{4}$ -inch wood stock into the top of the vertical flash arm and cut it off so it protrudes about $1\frac{1}{2}$ inches above the tubing. To this protruding end, attach the $1\frac{1}{2}$ -inch corner bracket as shown, using wood screws. Position a second 6-inch length of $\frac{1}{8} \times 1$ -inch bar stock over this bracket, allowing a $\frac{3}{4}$ -inch overlap so that the bar can be screwed to the top of the flash post.

Drill out all of the necessary holes and assemble the bar and bracket to the post. Drill a $\frac{1}{4}$ -inch hole in the opposite end of the bar to line up with the mounting hole in the lower bar.

With the square stock in the tubing, drill a $\frac{1}{4}$ -inch hole as shown. Raise the post 1 inch and repeat. Continue at one-inch intervals as far as you wish. These holes allow the height of the flash arm to be adjusted.

Next, insert a piece of welding rod into the desired hole and kink it slightly to keep it from falling out. (A rubber band will also help to hold it in place.)

Mount a flash shoe on the upper steel bar using a $\frac{1}{4}$ -20 machine screw. For further flash adjustment, especially important in close-ups, you may wish to add a ball-and-socket swivel between the shoe and your camera. These are available to fit a standard flash shoe and will accept the shoe on your strobe.

Shape the $\frac{3}{4}$ -inch plywood with a

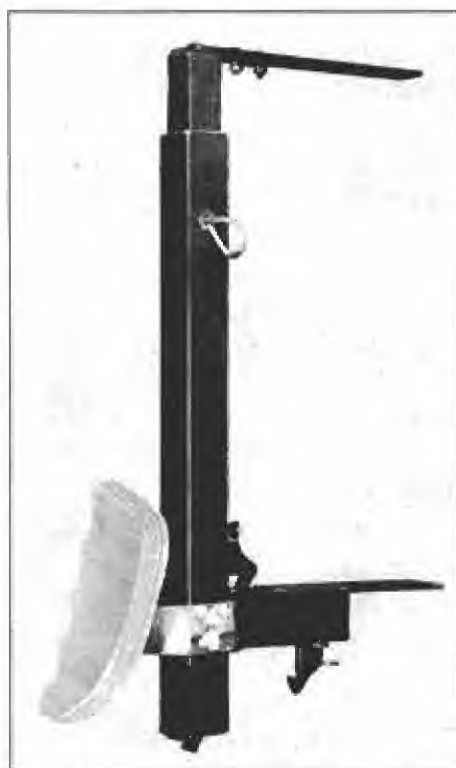


Diagram at top of page and assembled arm above show how easily parts go together.

coping saw to make a comfortable grip for your hand. Sand the edges smooth. Fasten the grip to the side of the vertical flash post using a right-angle bracket or a length of $\frac{1}{8}$ -inch bar stock bent to an angle.

Finish by gluing a rubber strip to the base plate and spraying the unit black. Attach your camera to the bracket, slip your flash in the shoe, and connect the strobe to the camera with an accessory coil cord. You should be cautious about using this bracket with wide-angle lenses as the angle of the flash may not be sufficient to cover the entire angle of the lens.

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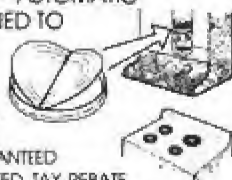


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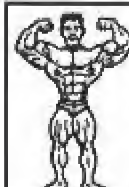
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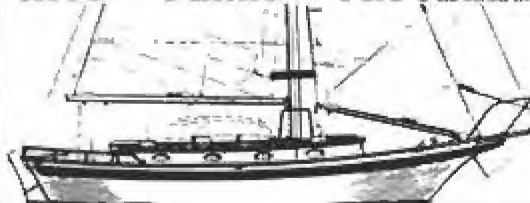
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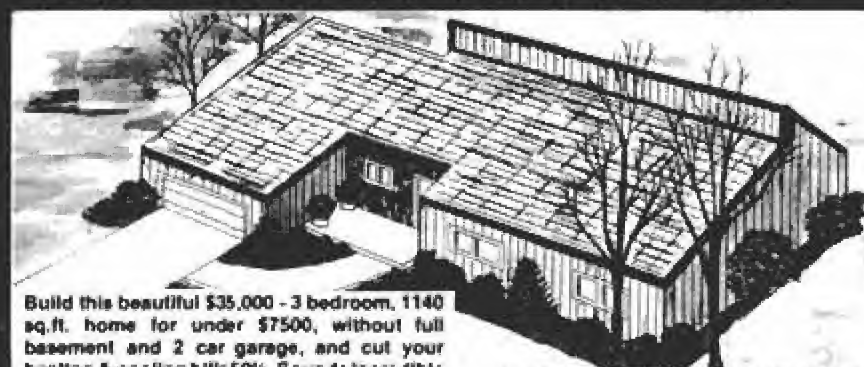
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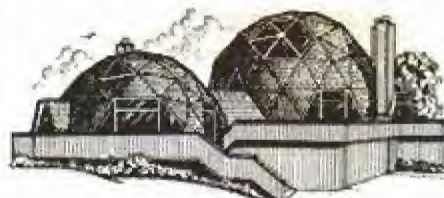
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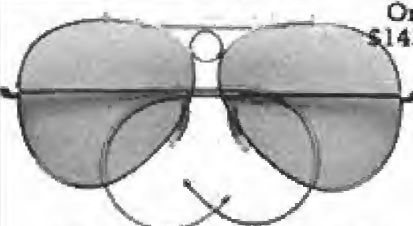
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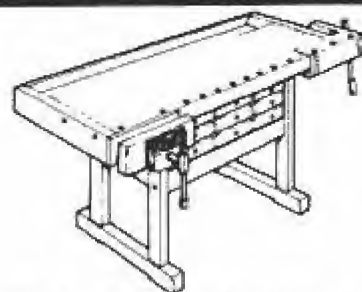
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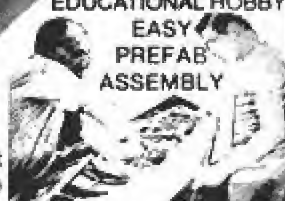
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